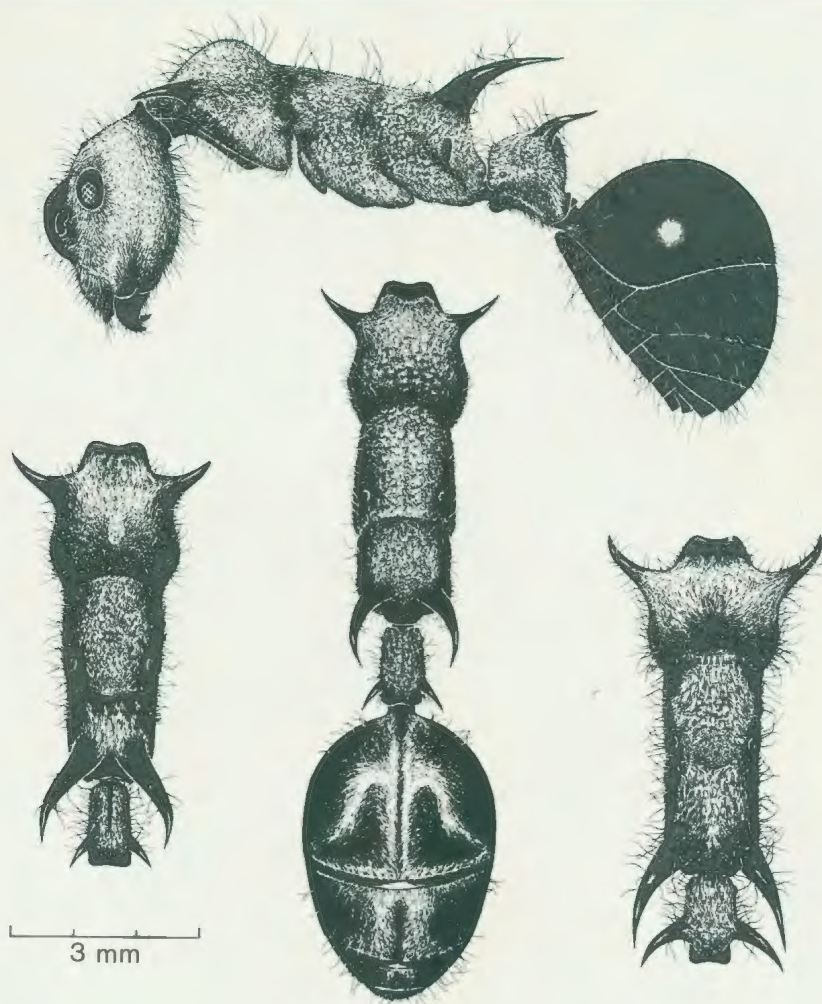


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THE DIARY OF WILLIAM FREDERIC BARNETT IN SEARCH OF LEICHHARDT

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ABSTRACT

Sixteen years after the disappearance of Leichhardt's fourth expedition, its fate was still a live issue. The eminent botanist Dr Ferdinand von Mueller could not accept that all members of the expedition had perished.

In 1864 Duncan McIntyre of Glengower via Castlemaine, Victoria, accompanied by William Frederic Barnett of Sandhurst, was searching for a sheep run in northwest Queensland. He found two old horses on the Dugald River (not known to have been left by any more recent explorer) and a little later two trees marked 'L' on the western bank of the Flinders River. He supposed he had found traces of the lost Leichhardt.

Dr Mueller was firmly convinced that he had, and persuaded the ladies of Melbourne to raise a sum of money to finance an expedition, led by McIntyre, to the locality. The expedition failed through no fault of McIntyre's and he in fact died in the field of 'gulf fever' on 4 June 1866.

Barnett, who had been with him for part of the expedition, was eventually appointed to command the expedition in December 1866 and between January and May 1867 carried on the search for Leichhardt, without success. His diary of proceedings in 1867 (hitherto unpublished) forms the principal subject matter of this paper.

What follows also reveals that the diarist, William Frederic Barnett, is not undeserving of a place in the annals of exploration in Australia. A shadowy, virtually unknown figure, the research generated by his diary has revealed him as a man who possessed courage, powers of endurance, leadership, and loyalty. These qualities do not appear to have had the recognition they deserved, either in his lifetime or afterwards.

INTRODUCTION

Included in the manuscript collections of the Queensland Museum, under accession no. 67/6114, is a manuscript diary. The catalogue card reads —

BARNETT, FRED. (Manuscript)
Leichhardt Search Expedition sent out by the ladies of Victoria. After Duncan McIntyre's death 1866, Barnett formed a party and continued the search.

Then follows a physical description of the diary, which includes the information that it commences on 20 January 1867 and concludes on 27 May 1867.

No provenance of the diary can be located in Museum records. It appears, however, that it was received sometime prior to November 1933 whilst the late Heber A. Longman was director and at a time when the Museum was desperately short of staff and funds.

It has been found that on 21 November 1933 Longman sent a type-script copy of the diary to the Mitchell Library in Sydney. He mentioned in his covering letter that Mr Arthur Jose (1), a mutual friend of the Mitchell Librarian (Miss Ida Leeson) and himself, had suggested that a copy of

the diary should be made for the Mitchell Library. The relevant correspondence has been turned up, but unfortunately throws no light either on the provenance of the diary.

In isolation the diary has little significance, but once the events which brought it into existence are led forward, it assumes importance as the terminal record of what appears to have been the last nineteenth century official effort to find traces of the lost Leichhardt expedition, which had been missing since 1848.

There are a number of other factors also which have to be taken into account in assessing the significance of the diary. There are the foundation of a new colony and the search for new pastoral runs involved. Furthermore one sees the value of exploration, quite apart from any hopes of finding Leichhardt, as a medium to gain knowledge of the colony's remote areas. This would assist materially in the colony's development.

Thus it was that after 1859 the new Colony of Queensland became the focus of attention of those seeking new pastoral runs. The Plains of Promise of Stokes, the first Leichhardt expedition, the tragic fate of Burke and Wills and the explorations of George Elphinstone Dalrymple all combined to

attract attention to North Queensland and to the northwest of the Colony in particular.

However, there was the matter of the western boundary of the Colony which was considered by Governor Bowen and the first Colonial Parliament to require adjustment. The letters patent of 6 June 1859 defined the boundary as 'the 141st meridian of east longitude, which is the eastern boundary of South Australia'. A.C. Gregory the Surveyor-General had advised the ministry that 'a boundary at the 141st meridian would just cut off from Queensland the greater portion of the only territory available for settlement, i.e. the Plains of Promise, and the only safe harbour, i.e. Investigator Road, in the Gulf of Carpentaria'. The local legislature asked for an extension of the boundary to the 138th meridian of east longitude.

After some importuning by Bowen, and evidently by certain gentlemen in Victoria who were desirous of forming a settlement in northern Australia (a phenomenon not unknown today), the Imperial Government acceded to the request. On 12 April 1862 the Duke of Newcastle, Secretary of State for Colonies advised Bowen that the Letters Patent had been issued annexing to Queensland that part of 'New South Wales as lies to the northward of the 21st parallel of south latitude, and between the 141st and 138th meridians of east longitude, together with all and every the adjacent islands their members and appurtenances in the Gulf of Carpentaria'. Queensland gained 120,000 square miles of territory, which now comprises such centres as Birdsville, Boulia, Camooweal, Burketown, Cloncurry and Mount Isa. (2)

THE MCINTYRES AND BARNETT

With the extension of the jurisdiction of Queensland a surge of settlement around the rivers flowing in to the Gulf of Carpentaria ensued. Some interested parties from the southern colonies even sought to overland their stock. Among these were Donald and Duncan McIntyre, (or M'Intyre or MacIntyre). The name was spelled variously, but I have adopted the spelling used in the Australian Dictionary of Biography, viz McIntyre.

Duncan McIntyre was born in Scotland in 1831 son of James McIntyre, a farmer, and his wife, Mary, nee MacDougall. He was probably orphaned when young and adopted by a relation, Archibald McIntyre, whose son Donald was often supposed to be Duncan's brother. McIntyre arrived in Port Phillip with his foster parents about 1849 according to the Australian Dictionary of Biography. However, other evidence indicates that an Archibald McIntyre and family arrived in the

ship 'David Clarke' in 1839. There is no record of such a family arriving ten years later, unless they were not assisted immigrants. (3)

Ultimately Duncan worked as station superintendent at Bullock Creek, Glengower near Castlemaine, with another relation, Donald Campbell. On 5 March 1862 at St. James' Cathedral, Melbourne, he married Mary Clyde Morris. In mid-1863 Duncan and Donald McIntyre decided to seek a run in the new country around the Gulf of Carpentaria. (4)

They left Victoria with sheep and work horses. On their arrival at the Upper Darling in January 1864 they found it to be in flood. Being unable to drive their sheep across they perforce had to halt. Duncan McIntyre, with a small party, proceeded north to find a good route to Coopers Creek. He found several new creeks and lakes and ascertained that stock could be taken without difficulty to Coopers Creek. On his return he learned that the Queensland Government had imposed an embargo on the entry of stock from other colonies, either by land or by sea. An application to bring their stock into Queensland having been made, the McIntyres explored extensively the country to the north of the Darling and in to Queensland. Good country was found to the west of the Paroo River, but no permanent water. Forced by this lack they returned to the Paroo. There they met, coming north along the river, William Frederic Barnett, a young man of about 22 years of age, who had then been in Australia for four years. As he is the author of the diary to be examined in this paper, it is opportune here to study his antecedents and how he came to be travelling along the Paroo in 1864.

As explained in my acknowledgements, Mr D.K. Muir of Balgowlah, New South Wales, has compiled a Barnett family tree, which I reproduce as Fig. 1. From this it will be seen that W.F. Barnett was the third son and fourth child of Dr Adolphus Barnett and his wife, Sarah, nee Newman.

For some reason, not yet ascertained, the family split up in 1853 when Dr Barnett and his son, Adolphus Robert, left the family home in Limehouse, London and came to Australia. After one month in Sydney, they went to Sandhurst (now Bendigo, Victoria) where Dr Barnett remained until his death on 14 February 1867 (5). In February 1860 his wife and three remaining children joined him. They had sailed from London on 22 November 1859 in the ship 'Kent' and arrived in Melbourne on 20 February 1860. The ship's passenger list indicates the family had

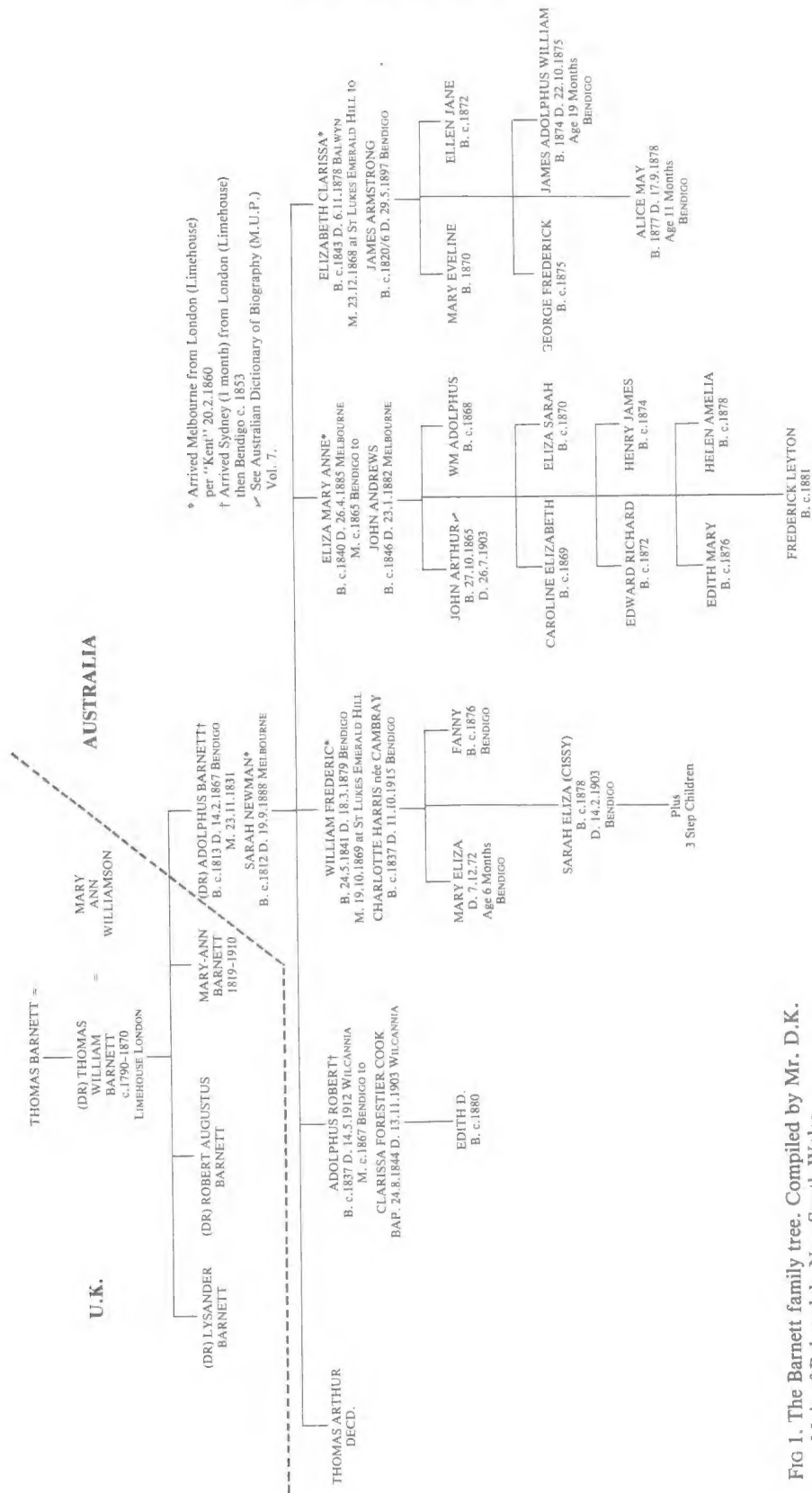


FIG 1. The Barnett family tree. Compiled by Mr. D.K. Muir of Balgowlah, New South Wales.

travelled as cabin passengers; evidently funds were not lacking. Also it states that Frederic was 14 years of age, whereas his father's death certificate and later documentary evidence indicate he was at least four years older (6).

Barnett had an aunt, Eliza, his mother's sister, of whom he seems to have been extraordinarily fond. In November 1864 he wrote a long letter to her from the River Paroo, New South Wales (7). This letter is a fruitful source of information about Barnett's colonial career and also regarding his meeting with the McIntyres and some of his subsequent dealings with them; Duncan McIntyre (Fig. 2) in particular. All the factual information which follows is derived from Barnett's letter to his aunt.

He had worked as a clerk at a bank in Sandhurst for an uncertain period but resigned because he considered 'the bank authorities treated me shamefully'. He stated he disliked desk work, had other (unstated) reasons for wishing to leave Bendigo and felt he would get on better in an occupation he liked. The letter refers elsewhere to his and family troubles without going into detail. Dr Adolphus Barnett became insolvent on 7 June 1861 (8). The problems created by this probably had their effect on Frederic.

Probably from early 1862 Barnett worked at a Mr Lintott's cattle station at Lake Bael Bael as a station hand, but was treated as one of the family. After eighteen months it was decided to put sheep on the run. Barnett was put in charge of a flock of 10,000 on the River Edwards in New South Wales and drove them safely to Bael Bael.

Lintott advised Barnett he should go into new country, where he would have a better chance to get on. If he was unsuccessful he could return to Bael Bael.

Barnett started up the Darling River to seek employment at the Bogan River Pastoral Company's station at the junction of the Darling and Warrego Rivers. He had not gone far up the Darling when he was met by the greatest flood in that river in living memory — white or black. After battling through flooded areas (sometimes travelling thirty-five miles to cover five miles of forward progress) he arrived at Mount Murchison station. Here he was informed that he would not be able to go further as the flood waters were spreading ninety miles back from the river a little further upstream. J.H. Heaton's *Australian Dictionary of Dates* (1879) confirms that there were floods in New South Wales during February to July 1864.

Ross Reid, the owner of Mount Murchison, gave Barnett a caretaking job. The homestead had



FIG 2. A portrait of Duncan McIntyre.

to be abandoned temporarily so Reid could go to look after his stock, which had been moved away from the flooded area. Barnett lived in the homestead which was on a knoll turned into an island by the flood. He had for a companion a young missionary, who was flood bound also and who turned out to be a first rate cook. Barnett was able to obtain plenty of ducks and pigeons for the cooking pot, so they lived well.

Being anxious to move on, Barnett considered closely the geography of the country to the north and decided it was possible to travel directly across to the Paroo River. He could go up this stream and then cross to the Warrego and thus come to the Bogan River Pastoral Company's station, his original destination. His 'mate' (the missionary) accompanied him. They procured rations from Mount Murchison, packed them on a spare horse and set out for the Paroo.

After 150 miles of travel they arrived at Putha Putha on the Paroo. The missionary learning that a gentleman, to whom he had introductions, had an out-station from the Darling about 60 miles away, decided he wanted to go there. Barnett saw him there safely and then returned to the Paroo. He proceeded up the river and nearing the Queensland boundary he met and joined the McIntyres and their party.

This meeting was of great significance for Barnett. Duncan McIntyre's influence on him was considerable and Barnett's ambition thereafter was to be an explorer.

For the next several years his life was closely interwoven with McIntyre's and even after the death of the latter his influence on Barnett continued to be strong.

It is necessary to recount McIntyre's story because what he did and what happened to him, motivated Barnett to follow in his footsteps and to write the diary around which this paper has been written.

The introduction which follows may seem long, but it enhances the diary by giving the reader a full knowledge of what brought into being Barnett's record of the final phase of the Leichhardt Search Expedition.

NORTHWARDS TO THE GULF

Barnett confirms that the Queensland Government would not allow the introduction of sheep or cattle for fear of disease and this had stopped the McIntyres from taking their sheep through to the Gulf of Carpentaria as originally planned. They were compelled to wait for a permit to enter the colony with their sheep. However Barnett says—

Duncan McIntyre was wishing very much to go on & explore the country to the Gulf; his brother Donald being quite sufficient to look after the sheep — but he wanted someone to go with him. It was just the style of thing to suit me and had he not proposed for me to accompany him I should have volunteered.

We at once set to work getting rations ready & packed & breaking horses for the journey. We determined our party should consist of — Duncan McIntyre, chief, Wm. Fred Barnett, second in command, & Albert, Charlie & Billy (blackfellows) our subordinates, 25 horses & 1 Kangaroo dog & our rations to consist of tea, flour, sugar & a little rice. I will now refer to my journal —

21 June 1864

We experienced much trouble getting the packs on, the horses being very fresh & a number of them lately broken. At last we were all ready to start when unfortunately a fold (sic — ?foal) of one of the pack mares got amongst our mob, not wishing to take it McIntyre desired me to cut it out. In doing so I disturbed the pack horses who when they began to move about felt their girths and packs rather disagreeable and thereupon they one & all commenced bucking shying & kicking & galloping until they had rid themselves of them; it was indeed a very deplorable yet most ludicrous sight which beggars description — We brought up the horses again, repaired the packs, got them on & at length started altho' it only wanted an hour to sunset. Donald McIntyre & McCloud come with us for a few days journey.

Sunday 3 July. We are camped to day on a beautiful lake never before visited by white men; as Donald & McCloud leave us tomorrow we have christened it

"Lake Farewell". The horses are now moderately easy to manage having become used to the packs — Write to my brother & shoot ducks for supper.

From Monday 4 July, McIntyre and Barnett were on their own with the three aboriginals and began to make their way towards Coopers Creek.

On this stage young Mr Barnett was brought face to face, albeit vicariously, with the perils of exploring and pioneering far from the haunts of one's own kind. The *Riverine Herald* of Echuca reported, after an interview with McIntyre on his return from the journey to the Gulf, in mournful detail —

... Nothing new was discovered in passing through the country which had before been explored by them, for two or three hundred miles, as regards the features of the country. But it will be heard with satisfaction by the relatives and friends of the late Mr. Curlewis, that his remains, together with those of his companion, M'Culloch, were discovered by Mr. M'Intyre, and that his fate has been placed beyond all doubt. The blacks pointed out the grave in which they were laid together, and described how they had been murdered. The bones were disinterred, and the skulls of both these unfortunate young men were found to have been fractured by blows from some heavy weapons. They were undoubtedly the remains of white men, and part of a bridle rein was found tied round them, as if it had been used by the blacks to carry the bodies. A piece of guernsey shirt, very much blood-stained, was also found. They were killed, it appears, about a mile from where they were buried, in a dry billagong. The excuse given for the murder was that Mr. Curlewis had coerced a black-fellow to accompany him to show him the country, and that this man, not liking to go, persuaded four others to assist him in killing the two white men. One evening, after the party had camped, this black fellow asked permission from Mr. Curlewis to go out to look for ducks. The permission was granted him, and he went away to the other blacks, and arranged with them to come at a given signal during the night. Having removed the firearms and planted them, he gave the signal as soon as the two travellers were asleep, when his accomplices came up and speared them, after which they smashed their heads in with waddies and tomahawks. This Mr M'Intyre believes to be a correct account of the murder. The remains were carefully re-interred, and the spot marked. A special note of the locality was taken, as Mr. Curlewis was well known to Mr. M'Intyre, and he was desirous of doing all in his power to honor the memory of the unfortunate deceased. (9)

Barnett did not recount this grisly tale to his aunt. His next journal extract is dated Friday 15 July —

Camped on Coopers River. Yesterday we passed over immense plains of roley polley (a very prickly bush); having much trouble in driving the horses over

them and continuing to travel long after dark for water we did not notice our dog had stayed behind, we shall have to go on without him tomorrow. Four blackfellows pass at some distance from our camp but do not pay any attention to our signs to come up. McIntyre and Charlie go out for game & return with a native companion, 3 ducks, 2 hawk & an owl.

Coopers Creek was crossed at 26° 10' south and followed up for twenty miles. They then struck out northwesterly over indifferent country for several days, which they found to be waterless. (10) Barnett takes up the tale again —

Sunday 24 July. Yesterday we left Charlie and Albert behind to find & bring up 4 horses which were missing the whole party not being able to remain as we had camped without water. They had not arrived this morning & as we had camped again without water, McIntyre & Billy proceeded with the horses & I remain to bring up Charlie & Albert. I go on a Stony rise that I may the more readily see the horses, should they come up, & lie down with the bridle of my horse in my hand. Presently I see two black objects approaching & bye & bye make them out to be two blackfellows; not knowing but that there may be more I mount my horse & look to my revolver. When within 200 yds they see me & their astonishment is evident — I cooey to them but they will not come up but alter their course to avoid me & as soon as they get to a bush make a fire & one of them stepping out in front with a fire stick which he kept waving towards me whilst he cried out some incantation in a loud voice; this having been completed they pursued their way. About an hour before sunset Charlie & Albert came up with the lost horses & without delay we started to overtake McIntyre; we had not proceeded more than 5 miles to a large dry creek of many channels when we met McIntyre and Billy returning with the horses.

They had met a large party of blacks who surrounded them & by their gesticulations appeared to be hostile — tapping their shields with their boomerangs & then their heads; McIntyre fired a shot close to the foremost one which rather intimidated them & as he imagined they had already killed me he had returned to find out or give me warning of their presence. Having seen to all the firearms & slackened the fastenings of our knives and tomahawks we started for where McIntyre had turned intending to make our way through the darkies should they oppose our progress for we had now been two nights & nearly 3 days without water & that period in this latitude is fearful. We had crossed nearly all the channels of the creek when we observed 15 or 20 blacks stooping over something very busily; as soon as they saw us they gave a yell & disappeared amongst the timber. We found that they had been busy ripping open one of our flour packs which had been thrown off by one of the horses & not noticed by McIntyre & Billy in their hasty retreat. Of course we halted to repair the pack, as we could not afford to lose nearly a cwt of flour; whilst doing so 20 to 30 blacks made their appearance &

pointed to their weapons which they had left by the pack; I carelessly threw them to them laughing at the same time, as well as my parched mouth would allow me, & made signs that we wanted water — they pointed the way we had come from.

Being painfully convinced there was no water the way the blacks pointed we determined to follow them as they were sure to go to water. They kept amongst the timber some distance continually jabbering in a loud tone & pointing the way we had come from; at length seeing we would not leave them & all of us making signs for water, they struck across a plane (sic) & at length to our great delight & relief came upon a small lagoon & having quenched our thirst we unpacked the horses & prepared to have a yarn with our unwilling guides who were watching us evidently much interested. We beckoned for them to come up & being joined by some more from a large camp we could see about two miles off, they did : soon they were rubbing our hands & faces pointing significantly to the flour as if they thought they were painted but when I showed them my arms & breast their astonishment was immense. We explained to them that we should stay here one night & then go away a long way; to show our power McIntyre shot a hawk & after giving them a few trifles we bid them good night giving them to understand that should they make their appearance during the night we should cause them to tumble down like the hawk.

They are a fine lot of men, wear no clothing & circumcise, are afraid of horses but only laugh when a loaded revolver is pointed at them. They have evidently never seen white men before.

Barnett, despite his youth and comparative inexperience, was shaping up well to the exigencies of the explorer's life. He had suffered the privations of thirst and had learned how an element of bluff could avert possible hostile confrontations with the natives. In McIntyre he had a cool headed, canny leader; but obviously he was good support material.

For a while they enjoyed better travelling conditions, having reached another water system in which four new rivers were found. The first of these was named in honour of the Rev. Joseph Docker of Wangaratta, one of the most generous supporters of the original Victorian expedition. From the Docker River, on a northwesterly course, they reached the Mueller River of McKinlay, crossing this watercourse in 23° south. Continuing their northwestern direction, they met about a degree further west, and in about 22° south, the very faint tracks of animals, seemingly either goats or sheep, and horses, at a spot not known to have been traversed by any explorer. (11) From this location a system chiefly of granite mountains extends in two main lines, southwest and northwest. The Mountain range was most difficult

to cross, as witness a further extract from Barnett's Journal as told to his aunt —

Thursday 4 Aug. We have had a dreadful day's work today over almost impassible (sic) mountains. The horses climbing up & when nearly reaching the tops having to go single file through little gaps ... the only possible places to get over the mountains crown-like tops; when they came to the precipitous descents they snorted back with fear & it was with great difficulty we compelled them; often I thought they would be dashed to pieces by losing their footing or when they reached the bottom for in their way they dislodged large blocks of rock which descending carried all before them & reached the bottom with a deafening crash. At length we came to a dry sandy creek with almost perpendicular mountains on both sides about 500 ft. high: as the creek was coming from the direction we wanted to go we followed it up hoping to get water near its head & cross on to the northern drainage tomorrow. We had not proceeded far along the creek when the bed was frequently of granite & boulders partially blocked it up; after much difficulty we got up a ravine or glen & in a granite basin found plenty of water. McIntyre went further up and found the channel entirely blocked up with immense granite boulders so that we shall have to turn back some distance tomorrow & try another pass. This is indeed a wild looking place; for about 20 yds width blocks of granite are heaped & strewn about in fantastic ways, then on either side there is a rugged incline for 100 yds from which the mountains go up nearly perpendicular for 400 to 500 yds. No feed for the horses who remain standing where we left them.

They had been making for the headwaters of the Albert River, but the range described by Barnett was that which Burke had reported as giving such terrible work to the camels that they groaned and bled. McIntyre and Barnett found their horses' feet got so much worn down by the rocks that it became necessary to follow a fall of water to the north, and afterwards to the northeast, in order to get down on to the low country. Barnett takes up the tale again —

Saturday 6 Aug. Yesterday after much difficult travelling we succeeded in getting on the northern drainage; we followed down a creek which soon led us to a beautiful valley & at the first water we came to we camped. Today as we continued along the creek we surprised some blacks who with frightful yells set fire to the grass & ran up the mountains which were not far distant. Fifty or sixty of them kept up with us for about three miles running along the top of the mountains shouting and yelling hideously. About three miles further on we stopped to take an observation of the sun & we found that our axe had got away somehow. Thinking that perchance it had been torn from the pack in some scrub we had passed through, I and Charlie start back in quest of it. We had gone about 3 miles when we heard a chopping over a small

ridge & imagining that very likely that blackfellow had picked it up & were using it we rode over the ridge & saw a blackfellow & his lubra busy getting a possum out of a tree. So busily were they engaged in their occupation that we were not observed until close up & I cough. They instantly sprang to their feet and dropping everything they had, stood for a moment or two in mute bewilderment & then with yells that made the mountains ring again, scampered off. Seeing that the blackfellow was using his own tomahawk (a sharpened stone fastened between sticks) & hearing yells in all directions I deemed it advisable to give up the search & returned to the party. We kept on until after sundown without seeing water but observing the sand in the creek looked damp in one place we made a hole which was soon filled with water; having enlarged the hole to get sufficient water for the horses, we shot two cockatoos & a pigeon for supper & camped.

These extracts will give you an idea of our journey. On the 28th August we arrived at the Gulf of Carpentaria but mangrove saltwater swamps & creeks prevented our reaching the sea beach & obtaining a sight of the ocean tho' we were within 2 miles of it. It was impossible for horses to cross the creeks, the bank being almost perpendicular & the tide running out very strong. The presence of 200 or 300

Hostile black

Rushing to the fierce attack

(2) Boomerang (sic) & waddy wildly shaking

(1) Reed spear in woomera firmly placing

rendered it foolhardiness to swim across & proceed on foot to say nothing of the alligators.

Barnett's essay into verse does not overstate the case as McIntyre states that when they were within a mile of the coast, having got in between two deep salt mangrove creeks, they were hemmed in by a large number of blacks, whom they were obliged to charge in order to get out. As the *Riverine Herald* says —

Happily, however, by preserving his presence of mind, he succeeded in scaring them so much that he had no occasion to fire on them, but he was deprived of the opportunity of getting a sight of the ocean, which he could only have obtained by showing fight and shooting a number of them. He considered, however, that this gratification would have been too dearly bought at a sacrifice of human life. But neither on the journey out nor back was a single blackfellow shot. Once or twice an encounter seemed inevitable, but by showing a firm front, and seeming to disregard their presence, the necessity was avoided.

SOUTHWARD BOUND

It seems desirable to repeat Barnett's concluding remarks about the journey in his letter to his aunt before moving on to the matters which appear to have been regarded as McIntyre's exclusive

province for publication to the world at large. Barnett says —

Having proceeded up the river Flinders about 200 miles on our homeward journey we came upon a newly formed sheep station — the nearest settlement to the Gulf. We continued up the river calling at the several stations that have lately been formed; from thence along Walkers creek, Landsborough Creek & on to the river Thompson which we followed up some distance & then struck across ~~Coopers River~~ — rather the Barcoo, on to the head of Bulla which we followed down until we came to a cattle station which has been formed since we started; here we got on our outward track & in a few days I was reading your letter & playing with our dog that we left at Cooper River going out & he had found his way home 300 miles, causing a good many to think we had perished.

I have given you an idea of our homeward course—I can only give you our outward by saying that it was generally N.W. as we were endeavouring to make the Albert River (want of water prevented us). We crossed McKinlay's track about Lat. 25 Burke & Wills Lat. 20, Landsborough's Lat. 19 & recrossed Burke & Wills 18.30 so if you get a lately published map of Australia with the routes of the explorers on it & take into consideration that our journey was make(sic) in a dry season whereas the explorers had good ones & yet we never carried water tho' they did — that we travelled a greater distance in less time than any of them & came back in good health, you will have some idea what a great Australian pioneer I have become. Who would have thought the delicate boy would have grown to the hardy backwoodsman?

As it turned out, unhappily, he was not as hardy as he supposed. Generally McIntyre and Barnett agree on all but the odd small detail. In amplification of what Barnett had to say about the outward trip, it is noted that McIntyre says that once the northern coast range was crossed the Flinders River was struck at a point a little south of Donor's Hill (about 18°43'S. 140°33'E), from which it was followed for the first time to the sea (had the aborigines not prevented their covering that last mile or so). The journey from the Paroo to Coopers Creek took 22 days and the stage from the latter to the sea took a further 34 days, this period being little over half the time taken by either Burke or McKinlay.

McIntyre praised Barnett for his conduct during the trip. As already indicated in spite of his youth and previous inexperience in the bush he had shown a suprising aptitude for the work of exploring. The *Riverine Herald* of 31 December 1864 portentiously remarks that it will be gratifying to his Sandhurst friends to hear of Barnett's being spoken of in terms of high praise by Mr. McIntyre. (12)

TRACES OF LEICHHARDT?

Accounts as to when the incidents of note on this trip of McIntyre's occurred vary greatly. Some say they happened, but do not say when; others say on the way to the Gulf and others, again, on the return from there. However, a letter written jointly by Doctors David Wilkie and Ferdinand von Mueller to the Melbourne press on 21 December 1864 may be taken as authoritative as to the details and chronological order of the incidents. The learned gentlemen have this to say —

From hence [the animal tracks in about 22° south], a system chiefly of granite mountains sends its ramifications in two main lines south-west and north-west. On a new principal tributary of the Flinders River, rising on the north-west flank of this mountain tract, Mr. McIntyre passed to the main stream of the Flinders, observing in about 20 degrees 40 minute South and about one degree westward of Burke and Will's track, two old horses, an event to which not too much importance can be attached, when it is remembered that neither the Victorian explorers, nor Landsborough, nor A. Gregory, nor Leichhardt, in his first glorious expedition, abandoned any horses in any adjacent locality, Mr Walker's horses being left about 300 miles to the east. A still more important discovery rewarded Mr McIntyre's exertions after having reached on the Flinders line, the Carpentaria Gulf; for on his return journey whilst following up the main east branch of the Flinders River, he noticed on its western bank, in approximate latitude, 20 degrees south, two trees each bearing a large L, no number attached as a mark, indicating, as we, with Mr. McIntyre feel convinced, a Leichhardtian camp.

The tributary of the Flinders was named by McIntyre the Dugald River and that was where the horses had been found.

On the return journey McIntyre by keeping to the Flinders found that the coast range consisted only of high undulating downs without any stones. The difficult terrain of the outward journey, where water could only be obtained from rocky basins in gorges and no feed was available for the horses, could thus be avoided in any future journey. He found that the Flinders was settled from its head to within 280 miles of the sea. One station, however, was 130 miles lower down. The squatters on the river had lost about thirty per cent of their sheep from the poison bush coming over the ranges from east Queensland. Cattle losses had been considerable also from the poison bush and at least fifty per cent had been lost from the ravages of pleuro-pneumonia. A large percentage of horses had died from snake bites. Landsborough had presented the Flinders as a 'finely-watered' river, 120 yards wide and flowing. McIntyre found it dry

20 miles from the sea and higher up it was often dry for ten miles at a stretch and the general width was found to be 30 or 40 yards. Most of the stations were completely out of provisions. They were cut off by the drought from all communication with Port Denison.

McIntyre called at Bowen Downs Station at the head of the Thomson River and found the cattle there were all clean and in splendid condition, despite the dryness of the season. From there to Coopers Creek the country was well-watered but unstocked. McIntyre had planned to return near Landsborough's tracks, to the source of the Bulloo and from that river to the Paroo and accomplished the whole journey in twenty weeks. (13)

That McIntyre was convinced he had found traces of Leichhardt is evidenced by his hasty return to Victoria. As soon as he had reached the telegraphic line at Swan Hill on the Murray River he sent a telegram to the Secretary of the Royal Society of Victoria on the 15 December 1864 —

Found between Burke and Sturt tracks about 200 miles from Carpentaria two old horses and saw very old tracks of a party going south west; also two trees marked L about fifteen years old.

Duncan McIntyre
Glengower by Castlemaine.

Dr Robert L.J. Ellery of the Victorian Observatory the Secretary of the Royal Society, got in touch with Dr Mueller for his views as to whether McIntyre had come across some traces of Landsborough's party. Mueller replied promptly that no horses had been lost by Landsborough in his South West expedition from the Gulf of Carpentaria. Hence if the two L's were made by the party to which the horses belonged they could not be marks made by Landsborough. Mueller wondered if there might not be some mistake as to the distance from the Gulf of Carpentaria. He told Ellery that Mr Gregory had told Mr Giles of the discovery of other trees marked L at or about the Alice River. Mueller advised Ellery to publish the telegram. It appeared in the *Argus* with accompanying brief letters from Ellery and Mueller on 17 December 1864 and was republished in the *Australasian* on the following Saturday 24 December.

The almost immediate follow up by Drs Wilkie and Mueller appeared as already stated in the *Age* on 21 December 1864. This was republished in the *Australasian* on 24 December. Apart from the detail about the location of horses and trees already covered, the letter had this to say after

stating the conviction of those concerned that the two L trees indicated a Leichhardtian camp —

With this position the traces of Leichhardt, recently found on the Alice River, can be brought into a line of contact. These L's are clearly distinct from any marks of Landsborough's camps, who in that latitude kept the eastern bank of the Flinders River and who, moreover, attached a consecutive number to his marked camp trees. If further proofs of distinction were wanting, we might add that the bark had encroached to the extent of four or five inches on the incision of the L's, whereby a much greater age of the letters is established than that of Landsborough's camps; and still further we have evidence of one of the natives, who served both Landsborough's and McIntyre's expeditions, declaring the camp foreign to the expedition of the former gentleman. The position of these momentous trees being in flooded ground, it would have been in vain to search for further camp traces. Mr McIntyre, in carrying out a judiciously arranged plan, went homeward near Landsborough's tracks, to the sources of the Bulla (sic! Bulloo?), and finally from this river to the Paroo, accomplishing in twenty weeks a journey, by which he has secured a prominent and honourable position amongst our explorers, and this by slender and entirely private means, accompanied only by one of his countrymen and five (sic) aborigines.

Shall, whilst we can avail ourselves of the talents of tried and spirited travellers, like Mr. McIntyre and Mr. Giles, the fate of one of the most famed explorers which the world ever possessed, remain uncared for? Shall the destiny of him, who, in Australia, discovered the 'North-west passage', remain still for an indefinite period unascertained? And shall the revelation of the fate of this truly great man be any longer left to the chances of mere accident?

A lengthy account, entitled 'Late Explorations on the Shores of Carpentaria', of the journey of McIntyre and Barnett appeared in the *Riverine Herald* of Echuca on 31 December 1864. It was this article which was reproduced as a supplement in the *Brisbane Courier* of 12 January 1865. The L's on the trees were described in detail; McIntyre expressed the opinion that the letters seen were evidently cut by a skilled hand and could not have been the work of the blacks. The horses, which McIntyre had brought back with him, were also described. One was a bay and the other a black. There were illegible brands on both of them and each had a blotched brand on the same part of the back. Both were old horses. McIntyre said he had horses in his mob fifteen or sixteen years of age, which performed the whole journey well, while the two picked up by him knocked up in a very short time. This indicated they must have been of great age indeed, for when found they were rolling fat.

MUELLER AND THE LADIES OF MELBOURNE

On 9 February 1865 Dr Mueller gave a lecture at St. George's Hall, Melbourne on 'The Fate of Leichhardt'. In his own words —

"some space of time has elapsed since Dr. Wilkie and myself drew public attention to the important bearings of Mr McIntyre's researches on Leichhardt's fate, without any champion appearing for the lost explorers; and on consulting with my honourable friend, we felt that our call should not be suffered to die away, and resolved that it should be renewed in the present demonstration".

He then went on at great length to discuss the possible ends which Leichhardt and his party had met; murdered by the natives; destroyed in a terrible hailstorm; drowned in a flood or burned in a bushfire. On the other hand they might have lost their livestock to poison weed and be living marooned in an area, which might be capable of sustaining them on a subsistence level, but from which neither retreat nor advance was possible. It was a very dramatic presentation and aimed at the ladies of Victoria in an endeavour to enlist their support for a fund raising venture to finance a search for Leichhardt based on the seemingly new evidence found by McIntyre. He advocated the services of McIntyre should be secured. Mueller said —

This traveller entertains a persuasion, in which I fully share, that Leichhardt's fate can be discovered, and is inspired with an enthusiasm for bearing the standard of geographic science still further through this continent. With calm judgment he combines trained knowledge, travelling experience, an earnest will, and an unflinching perseverance; and above all he is willing to sacrifice private interest in the good cause. I am commissioned by Mr McIntyre to state, that whosoever in Leichhardt's search will take the field may unhesitatingly command from him every information calculated to secure success.

At the end of the lecture several men addressed the meeting. A deputation was appointed, consisting of Drs Wilkie, Crooke, Eades, Embling, Bleasdale and Mueller and Messrs Summers, Bonwick and Kyte, to wait on the heads of the church sections to solicit that the measure suggested by Dr Mueller, to call the ladies together for delegating representatives to a central committee be carried out. The central committee would, when appointed, solicit funds to finance a search for Leichhardt. (14)

The enterprise, needless to say, attracted some attention. A Mr S. Deveson of Little Bendigo, Ballarat, came up with the suggestion that if an expedition was sent it should be supplied with

materials for making a number of fire balloons. One should be sent up each evening when the relief party came to country considered by the leader 'to afford a reasonable prospect of proving serviceable to the lost men'. Mr Deveson expressed the view that any survivor who sighted the fire balloon would at once conclude that civilised beings were in their vicinity and would use every effort to come in contact with them. (15)

John Roper, who had accompanied Leichhardt to Port Essington wrote, from the River Acheron in Victoria's southern highlands, to Dr Mueller expressing his gratitude at the efforts being made to promote a search his old friend and leader, Leichhardt. He wished the endeavour every success and hoped that at last the world would find what had happened to Leichhardt. (16)

A.W. Howitt also wrote to Dr Mueller. He said he had questioned the natives about parties of white men in the interior and had done this as far as latitude 25°30' south. Because of his ability to speak the language of that part of the interior he could be sure of understanding and making himself understood. He found that the natives were acquainted with the movements of Sturt's party, Gregory and the later explorers. He could never gain the least intelligence about such a party as Leichhardt's. In the circumstances Howitt considered that their traces must be sought considerably north of the latitude he had mentioned. This supported the hypotheses of Mueller and McIntyre. (17)

However, all was not sweetness and light. A discordant note had been struck, about three weeks before Howitt's letter, by a gentleman who signed himself 'A Murray Squatter'. He wrote from Kasima on 28 April 1865 to the *Riverine Herald* as follows —

Can you inform me and many others who really think that something should be done to learn Leichhardt's fate, what has been done or is to be done about this Leichhardt expedition. I have received a circular from the Ladies' Committee, written with great taste and good feeling, as might be expected, but we want something more than taste, or even good feeling, in fitting out such an expedition. There was enough of both and to spare in that most woeful Burke and Wills affairs, yet see what a miserable end they came to. To initiate, and even carry on, such a benevolent movement, to enlist sympathy and collect funds, the ladies are admirably suitable; but imagine sixteen ladies selecting horses and bargaining for saddles in Bourke Street. Of course, they will leave all that to others but to whom? Who is to be the leader? Who have the ladies to consult and advise with as to the choice of a leader? And who is that leader to consult with as to his general proceedings? A man must

be chosen who may be entrusted with everything, but upon many points any prudent man would prefer being supported by other men's opinions. There must be a pre-arranged route, for instance, and who is to lay it down? Certainly not the leader unrestricted; it would be unfair to him, for if, for one thing, he found good sheep country and applied for it, it would undoubtedly be said that he had paid much more attention to his own interest than the public object of his journey, as was freely enough said of more than one of disinterested searches after Burke and Wills; and the best man if unrestricted, might be biased by an anxiety to bring the expedition to a close, to secure some paradise he had discovered. This has been originated by Dr. Mueller and Dr. Wilkie's report, and I would like to know if they are the ladies only advisers. They are both very good men — the first is a botanist of European reputation, and I believe thoroughly acquainted with the whole subject upon paper, but both too much mixed up with Burke and Wills failure to give entire confidence to this if placed under their auspices. In fact, not to make too fine a point of it, people won't have them, that is alone; associated with others their unfortunate experience might be useful. I am ready to subscribe £10 or £20 if I can see that it will be carried out practically and efficiently, but with the greatest respect for the ladies, I should like to know who they intend to appoint, and who are to assist them in arranging with him as to his proceedings before I subscribe, and I can say that almost everyone I have spoken to is of the same opinion. (18)

Dr Mueller, three weeks later, replied to the Murray Squatter at considerable length, ostensibly to shield Dr Wilkie against an attack which, had the Kasima gentleman been acquainted with all the facts connected with the first Victorian expedition, he could never have ventured.

The Doctor pointed out that neither Dr Wilkie nor himself were involved with the arrangements which led to the disasters of the Burke and Wills expedition; in fact they were both opposed to the decision which led to its sad fate.

Now that he had entered 'the arena' Dr Mueller took the opportunity to repel the attacks against himself. He pointed out that since 1848 he had travelled about 24,000 miles within Australia and no one can say he had ever deviated from public duties for the sake of personal interests. He treasured his reputation and would not hazard it in promoting the ladies' enterprise other than for altruistic motives. Murray Squatter should be aware from practical considerations that a safe and tried explorer like McIntyre should not be fettered in the details of his operations. Rather than seeking to impede the objects of the enterprise every right minded person should be seeking to assist the ladies. It had been stated months ago that the ladies, when the fund was obtained, would go to

gentlemen for advice that might be needed and seek from them the counsel for practical initiation of their enterprise. (19)

Mrs Eliza S. Bromby, the president and Mrs Ellen Tierney, the Honorary Secretary, of the Leichhardt Search Committee sent a telegram to Lady Bowen in Brisbane. It read:

The Victorian Government will bear a share of the expenditure which may be incurred in prosecuting a search of Leichhardt if other Governments will assist. If Queensland will contribute liberally say £1,000 — the expedition can be organised immediately; otherwise the services of Mr M'Intyre (sic) and the advantages of instituting the search a year earlier will be lost. Private contributions will soon amount to £1,000. Pray send soon an answer; surety to be given that no squatting interest will be pursued.

On 3 June 1865 Lady Bowen received a further telegram from Melbourne:

South Australian Government announces its decision to recommend unconditionally a vote for the Leichhardt search to Parliament.

Lady Bowen replied on the same day:

The Queensland Government will recommend to Parliament a vote for the Leichhardt Search. I will form a Ladies Committee to receive contributions.

The Brisbane Courier stated,

after her return from Ipswich, Lady Bowen will call a public meeting of ladies with the object of forming the committee referred to. Meanwhile, contributions in aid of the 'Leichhardt Search Fund' will be received by Captain Pitt, R.A., Government House. Subscriptions already received:— Sir George and Lady Bowen £5; Hon. R.G.W. Herbert £2; C. Fitzsimmons Esq., M.L.A., £5. (20)

On 20 June 1865 the Rev. W.B. Clarke, well known for his geological researches in Australia, wrote from Sydney to Dr Mueller expressing his strong support for the Leichhardt search. He said that in 1858 he had canvassed the New South Wales Government to prosecute a search for the lost expedition to clear up the mystery of Leichhardt's disappearance and had recommended the search be concentrated upon the area between 25° and 28° south latitude and between 144° and 148° east longitude (an area of just on 100,000 square miles). The Rev. Clarke notes with satisfaction that McIntyre's discoveries had been within that region, as the New South Wales Government had not given any support to his proposal. (21)

The *Australasian* of 1 July 1865 also contained an item of topical interest —

Mr. Donald Campbell, of Glengower, deserves much credit for the spirited and disinterested manner

in which he completed in the metropolis all arrangements for the Leichhardt search, acting on behalf of his nephew, Mr. McIntyre, who takes command of the expedition. Those members of the party who are not yet with Mr. McIntyre, on the Darling, are required to be at Glengower by the end of the week, from whence they will then start with the camels and horses for Mount Murchison without delay. Provisions will be brought from one of the Queensland ports to the sources of the Thomson River. For the long keeping of the dromedaries the colony is indebted to the Messrs. Samuel and Charles Wilson of the Wimmera.

THE SEARCH FOR LEICHHARDT

On 3 July 1865 the Leichhardt search party left Glengower at mid-day [it was a Monday]. According to the *Castlemaine Daily News* all the men seemed accustomed to bush life and endurance and mostly of middle age. None of them, however, excepting the leader, Mr McIntyre and Dr Murray, the second in command and surgeon, had been in previous expedition parties. Mr McIntyre was then supposed to be about 500 miles from the Gulf and was to meet the party on 1 August on the Darling. In the meantime the party was to travel under the leadership of Dr Murray and Mr Gray, the latter being an experienced bushman. A lengthy letter from William Landsborough to the *Queensland Guardian* was at his request republished in the Victorian press. It expressed some practical views on the *modus operandi* of the search for Leichhardt. Landsborough appears to have been under the impression that Howitt would be accompanying the expedition as surveyor and journalist; duties which should not devolve on McIntyre as leader. However, in a footnote to the letter Landsborough says

Dr. Mueller has just ordered me to send a quantity of provisions to Cornish Creek, one of the heads of the Thomson; and has informed me that the dromedaries are about to be taken to the Darling, and that Dr. Murray (of Howitt's expedition in search of Burke) is to join the party. (22)

Dr Murray will be discussed at length later on, but suffice it to say at this stage it was Mueller's and the Ladies Committee's fatal mistake when they appointed him as second in command of the expedition.

A Queensland letter of 1 July 1865 which appeared in the *Australasian* on 15 July 1865 indicated that Queensland, led by Lady Bowen, was putting its best foot forward to raise money for the expedition.

The Government of Queensland was expected to give at least £500. It was believed Queensland

would bear a fair share of the expenses of the expedition.

Then full of praise for the generosity of the Legislature and people of Queensland Dr Mueller published a letter he had received from Mr Gordon Sandeman, M.L.A. for Leichhardt (Q) which informed the Doctor that the Queensland 'House of Assembly' had voted £1,000, in aid of the 'Leichhardt Search Fund', by a large majority. (23)

After the Queensland parliament had voted £1,000 in aid of the search for Leichhardt Sir George Bowen, the Governor, sent a very full report about the whole matter to the Secretary of State for the Colonies. From Bowen's despatch we learn that the Victorian and South Australian Parliaments had each voted £500. Private contributions amounting to about £1,500 had also been collected, mainly in Victoria and Queensland. The total collected being sufficient to maintain the expedition for two years, it had already started on its journey. Bowen then gave an account of Leichhardt's career as an explorer and of the search expeditions mounted for him after his disappearance. He went on to say, despite Hovenden Hely's report of a native account of a massacre of the whole party about 200 miles west of Mount Abundance, later explorers had found traces much to the north of the reported location of the massacre. Eventually, Duncan McIntyre's discoveries of horses and marked trees in 1864 led to those, particularly Dr Mueller, who had never ceased to urge the probability of Leichhardt or some of his party still being alive, to espouse the cause of a renewed search for the lost explorer and members of his expedition. Bowen mentions Buckley in Victoria and Morrill in North Queensland as examples of survival among the aboriginals in the Australian bush.

The Governor mentioned how the Victorian Ladies' Committee had enlisted the aid of Lady Bowen, who had obtained the assistance of Queensland ladies of social influence which had been successfully exercised in obtaining the liberal aid which had been received from the Colonial Parliament.

Bowen expressed the view that whatever the outcome of the expedition it must add to the knowledge of the remoter portions of the colony and assist materially in its development.

In conclusion the Governor informed the Colonial Office that Duncan McIntyre had set out from Victoria some months before. The rest of the party was now moving to meet him and the expedition was to be finally organised in

Queensland. It would consist of eight to twelve carefully selected 'bushmen', 14 camels and about 40 horses. It had the means to have supplies for two years. The expedition would proceed first to Flinders River where the last traces had been seen by McIntyre. From thence it would proceed towards the interior. Bowen said the expedition would receive every assistance. It will be able to procure fresh stores from time to time from Burketown, the new settlement recently established on Bowen's recommendation at the head of navigation of the Albert River flowing into the head of the Gulf of Carpentaria. (24)

On 21 August 1865 near Mount Murchison McIntyre took charge of the expedition. On 23 August the party moved on and on 5 October was camped at Curracunaya Springs.

BARNETT JOINS THE SEARCH

When Barnett returned with McIntyre from the Gulf of Carpentaria in November 1864, he intended at first to pay a visit to Bendigo, but, again quoting from his letter to his aunt:

a journey of 1200 miles ('tis at least 600 to Bendigo) is a great loss of time and with me time is more valuable than money & tho' it would be a great pleasure to me yet the pleasure to all parties will be greater the longer I stay away & the better lining I have to my pocket when I do go, so I will have another trip somewhere first.

I am having a spell now for a little bit — living like an eastern king. On either side of me is black girl squatting down ready to fetch a light to my pipe or a drink or any thing else I may require. Don't blush when I tell you they are as naked as the day they were born; its their fashion. Outside the gunyah my black boy is lying asleep ready to fetch my horse or whatever I order him & this morning I started half a dozen blackfellows & their lubras the former to net ducks and the latter to catch fish, some of which I shall have for my supper.

A young man's boasting, perhaps. In any event he stayed in the Warrego area and took up employment there, probably with the Bogan River Pastoral Company, as he had intended to do much earlier.

However, upon his receiving a letter from Duncan McIntyre, which informed him of the Leichhardt Search Expedition, Barnett left his employment and hastened to Glengower, where he was mortified to find the Leichhardt Search Expedition had started off a few days before his arrival.

Donald Campbell advised Barnett to go with the expedition and assured him he would have an equal command with Dr Murray. Returning up the

Darling, Barnett met Duncan McIntyre only to be told by him that on account of the arrangements already made, Barnett could only accompany the expedition as one of the men under McIntyre's own leadership. Barnett said he was satisfied to do this. (25) This is a fair indication of his loyalty to Duncan McIntyre and the trust he reposed in him.

Barnett was deemed to have joined the expedition on 10 September 1865. The remuneration he agreed to accept appears to have been £78 per annum, judging by the fact that when he left of his own accord on 24 March 1866 he received £35. In addition, of course, he received rations. These facts are revealed in a letter of Barnett's which was published in the Melbourne *Argus* newspaper on 2 December 1867.

Two reports both dated 30 March 1866 were sent to Dr Mueller and the Search Committee respectively by McIntyre from the Gelliot (Gilliat) River covering the period from October 1865 to March 1866. The first (to Mueller) reads:

In writing to you a full and particular account of everything of importance connected with the expedition from the time it left the Darling, New South Wales, until its arrival here, and especially of what took place in the neighbourhood of Cooper's Creek. we came nearly straight from the New South Wales boundary on the Pine River to Cooper's Creek, where it turns south, or from about 29°S, 144°30'E, to about 26°S, 142°E. and nearly in a direct line from there to the intersection of the tropical line and Mueller River, and afterwards almost direct to [Mount] Fort Bowen.



Fig 3. Typical tree blaze to mark campsites.

or the point from where I was directed to commence the search. The search has been commenced, and will be carried on while it is possible to go on with it. Along with our doctor and some other members of the expedition we lost some thermometers, &c., all of which I will try and replace at the settlement on the Albert (Burketown), and also a surveyor if there is one to be had. I have kept a complete field book and journal from Cooper's creek to this point, all the important geographical features being ascertained as near as possible, and the position of the camps ascertained to a tenth part of a mile, five or six observations on each side of the zenith being taken almost every night. We have still four thermometers and two barometers (such as were sent up with the expedition), two large sextants, a number of small ones, and eight compasses, so that, allowing none are to be had on the Albert, the expedition is pretty well supplied. I am doubtful about being able to get a legally qualified surgeon; and a surveyor capable of making astronomical observations is still more difficult to procure; other men are plentiful enough. The other part of the expedition, except in horses (and I will arrange about getting enough), is still all right; in fact, I believe the most complete that ever started. I expect you will get my other letter as soon as this, when you will know all about our movements. I have sent a hurried despatch to the committee along with this. You must excuse this scroll (sic), for I am really very busy, but I suppose you will be glad to hear something of what we are doing.

The despatch to the committee was addressed to the Hon. Sec. of the Ladies Leichhardt Search Committee, Melbourne, Victoria. After dealing with the party's movements to Curracunaya where they stayed:

until the 11th November, when, although not quite ready, we were obliged to move on, as the water was nearly done. Leaving Curracunaya the expedition consisted of sixty five horses, twelve dromedaries, about five tons of stores and ten men:— Duncan McIntyre (sic) (leader), James P. Murray (surgeon and second in command), John McCalman, William F. McDonald, Alexander Gray, John Barnes, Belooch (Indian camel-driver), Welbo and Myola (aborigines).

On the 13th November, we crossed the Bulla [?Bulloo] and on the 17th reached the Wilson, which was followed up for some days. Late on the night of the 26th we arrived at Cooper's Creek and found it quite dry. As soon as day dawned Welbo and I started to look for water. We didn't go far. After a careful examination of the bed and banks of the channel, and old native footpaths, we returned to the expedition camp, and soon afterwards the party started back along the expedition track towards the last water. This retreat ended in the loss of all the horses but three, and the return of Dr. Murray, Gray, McDonald and Barnes to the settled districts.

The whole of December was lost in finding permanent water in Cooper's Creek and collecting

stores, firearms, ammunition, instruments and other valuables, which, owing to the expedition being declared at an end by the officers in charge, had been thrown anywhere and anyhow, or carried away on the horses. On New Year's Day we were camped on a fine sheet of water on Cooper's Creek. But as the dromedaries required a month of two's rest, and the natives troublesome, we moved a few miles up the creek to where there was good feed and timber. By the 14th January we had a stockade up, and the annoyance from the natives was at an end. In a few weeks the horses and dromedaries got quite fresh, and an unlimited supply of the finest fish put us all to rights. On Friday, the 9th February, we packed up and started. The expedition leaving Cooper's Creek consisted of twelve dromedaries, five horses, nearly two tons of stores and six men:— Duncan McIntyre (leader), John McCalman, William T. [?F] Barnett, Belooch (Indian), Welbo, Myola (aborigines).

On Sunday, the 18th February, we were enjoying ourselves in the clear water of the Docker River, and on the 1st March we left the Mueller, and almost immediately entered the tropics. On the 9th March the coast range was crossed, and the next day we came on the head of this river, which we traced down. On Sunday, the 18th March, the expedition was camped on the east side of the Gilliat [Gilliat] River nearly opposite [Mount] Fort Bowen. Welbo and I started to see if there was a station in the neighbourhood; a few miles in an easterly direction brought us to the Flinders River, which we crossed, and soon after we met a stockman looking for horses, who conducted us to Mr. Gibson's station near Mount Little. I was informed at this station that no further traces of Leichhardt had been observed, and that natives were seldom seen in the neighbourhood. After resting a few hours we proceeded to Mr. Morresell's station, about twelve miles up the Flinders and only a few miles below the LL trees, Leichhardt's supposed camp. We got to the station by sundown and remained all night. Mr. Morresell told me that the old camp near the station was the only trace of Leichhardt that he knew or had heard of on the river. I remained all Monday with Mr. Morresell, and on Tuesday, the 20th March, returned to the expedition camp. Since then Welbo and I have been searching for marked trees and other traces of Leichhardt down this river [Gilliat], up the Flinders, and across to the Cloncurry, but have not found any, neither have we been able to find any natives.

The dromedaries, although in good condition, are leg-weary, and will require a few weeks' rest before starting into the western interior. In the meantime the search will be going on, and, if possible, the natives of the district found and interrogated, and, perhaps, some of them attached to the expedition. (26)

DR MUELLER CONFIDES IN DR PETERMANN

This is the longest surviving personal report from McIntyre to the Ladies' Committee which has been located. Yet, in the 1866 issue of *Iustus*

Perthes Geographical Institute Bulletin (*Mitteilungen aus Justus Perthes Geographischer Anstalt 1866*) edited by Dr A. Petermann and published at Gotha in Germany, there appeared an article entitled *The Expedition in Search of Leichhardt in Australia, 1865 and 1866* (*Die Expedition zur Aufsuchung Leichhardt's in Australien, 1865 und 1866*). Dr Mueller is cited as the source. After briefly canvassing the beginning of the expedition, the misbehaviour of Dr Murray, who doled out brandy, while McIntyre was off in search of water, the subsequent reorganisation of the expedition and its inconclusive results due to McIntyre's death, the main content of the article is a report by McIntyre from the Gregory River dated 2 May 1866. The letter from McIntyre (which is referred to as incomplete) reads, in part, as follows:

I wrote to you about 5 weeks ago from the Gilliat River, including with my letter reports and papers from the Expedition. The camels, horses and men needed a few weeks rest. I took on a man named McLeod and two black boys that my brother had brought with the stock, along with 7 horses. On the 2nd April I broke camp in order to search for further traces of Leichhardt and in order to purchase some more provisions at a harbour.....

We went up river and reached the so-called town [Burketown] or the harbour. Its inhabitants numbered about 60, and of these about 45 or 50 had the fever. People were sick everywhere. I could not find 10 that were in any condition to work. I made camp by a lagoon about a mile from the town, and believed by doing so that I was out of the area of infection. There were two tents near us. By the next morning one of the occupants of these tents was dead, and when I went up to the town I found that two others had died here during the morning. I took some provisions with me and made camp 16 miles further upstream, but even while we were loading up the horses, one of the black boys came down with the fever and this morning McLeod has fallen ill with it. The boy will probably pull through, but McLeod has given himself up for lost. I am ready to travel on and am only waiting for the men to recover, which will be in a few days, I hope. It doesn't last long—either you're in your grave within a week, or else you're better.

Before I came here, the town numbered about 80 people, 66 of whom got the fever. They tell me that in all, 25 have died and at the moment they are making the coffins for two whose condition is hopeless. I hope I escape healthy. People are hurrying away as fast as they can by water and across country. There are two storehouses here, plenty of flour, tea and sugar, but the quality is very poor. We can hardly eat the flour, which is quite sour. The town also has two hotels. It lies on a plain, a few feet above sealevel. Perhaps there is something strange in the air this year, but all the aborigines seem to be quite well.

Up until now, we have come across no definite trace of Leichhardt, but we are quite sure that there are still white people living now among the aborigines, or they have been living with them within the last ten years. A boy and a girl, 10 to 12 years old, almost white, with blue eyes and red hair live there. In another tribe there is a girl of about 15 years old, in a third there is an adult female of about 18, and the rumour has it that a white man is living with a large tribe of about 200, a day's ride from here....

Since leaving the depot camp on the Gilliat, we have explored about 500 miles of new country, mostly along the northern slope of the coastal mountains. In the course of this we crossed over an area, which will undoubtedly prove to be a rich goldfield in a short time. We did not, in fact, find any gold, but from the formation of the terrain I have no doubt of its presence.

Should the search in this area prove to be fruitless, we will immediately cross over the coastal range and continue our explorations in the area around the southern or inland water courses, in a southwesterly direction, perhaps towards the Swan River.

The article continues with a statement that soon after writing this incomplete letter McIntyre returned to the depot on the Gilliat, taking with him W.F. Sloman from Burketown, whom he had engaged to act as second in charge of the expedition. On 20 May McIntyre was on the Dugald River (the McKinlay route). He left there in haste on 23 May, alone, to cover the 50 miles to the Gilliat in order to pick up the rest of the expedition from there. He was unwell at the time and arrived at the Gilliat depot completely exhausted. His condition worsened and he died on the morning of 4 June 1866.

McIntyre had not kept a journal for the last part of his trip. He had trusted to his memory and notes written in his field book. Sloman expressed a desire to put these together, but pointed out that complete notes, a field book and journal existed for the journey as far as the Gilliat River, including the geographical position of all camps. On 7 June Sloman had written to the Committee notifying them that he had two men, 11 camels, 32 horses and considerable provisions, that he was in the Gilliat area and awaited orders from Melbourne. The Committee had made no decision by the end of July as to the expedition's future, other than instructing Sloman to be ready to continue on receipt of word to do so.

Dr Peterman concludes the article with reflections on how this expedition reveals anew the gigantic difficulties facing all geographical expeditions. The English newspapers from Melbourne contain many criticisms of such expeditions and may be right to some extent from

the material point of view. However, the good doctor expresses the opinion it would be a sad day for humanity if all thought this way. He thanks providence for such enlightened and dedicated men as Dr Mueller, the Director of the Melbourne Botanical Gardens, who worked so hard to bring this expedition about.

No trace of McIntyre's letter of 2 May can be found in the Melbourne press. Its incompleteness may have been the reason why Mueller did not release it to either Committee or press. Again he could have been motivated by a wish to play down as much as possible what had happened to the expedition at Coopers Creek, which will be dealt with fully by me at a later stage in this article. Despite everything Mueller could not resist sending McIntyre's letter to Dr Petermann in far-off Germany for publication there.

In setting out the composition of the party the *Age* and *Weekly Herald* omitted one member—William F. Barnett. It could be that Barnett and McDonald had similar initials and the scribe omitted the second person inadvertently. Barnett had accompanied McIntyre in his 1863-64 venture to the Gulf and could be counted on not to desert, as becomes apparent when M'Calman and Barnett are McIntyre's only white followers at and after Coopers Creek. The *German Geographical Bulletin* of 1866 does confirm Barnett's presence in the expedition.

THE POOR CONDUCT OF DR MURRAY

Sir George Bowen sent the Colonial Office a copy of McIntyre's report of 30 March 1866 (which had appeared also in the *Age* on 30 May 1866 and the *Brisbane Courier* on 14 June 1866). Bowen comments that the Gelliot [Gilliat] River where McIntyre had been encamped is supposed to be a tributary of the Cloncurry River, but may enter the Flinders higher up than the Cloncurry. The camp near Mount Bowen, named by Landsborough would be in the vicinity of 19° 12' S, 140° 55' E. Mr A.C. Gregory believed the 'Docker' is a tributary of the Barcoo, which joins it from the north west in about 26° S; the Mueller is probably a tributary of the Thomson River coming in on the west side at about 24° S. I think A.C. Gregory placed the Barcoo and the Thomson too far to the west.

Bowen also had noted that the expedition had narrowly escaped perishing from want of water at or near Coopers Creek during the severe drought of early 1866. The expedition was deserted by Dr Murray, the second in command and surgeon, and by others who had returned to the settled districts.

The circumstances surrounding this had not yet been fully explained. (27)

The drought referred to by Bowen had in fact commenced in early 1865 and was at its worst in late 1865 in the Coopers Creek area.

I was able to find one contemporary and two later accounts, apart from those of McIntyre and Barnett, of the events surrounding the near disaster the party suffered at Coopers Creek. It is in regard to this that my earlier remarks, about the fatal mistake made by Dr Mueller and the Ladies Committee, can be explained now.

Dr James Patrick Murray, whom they appointed second in command and surgeon of the expedition, was a peculiar person to say the least. He had a comfortable social background, a manner that could win friends when he wanted them, and an erratic streak that often came close to madness. He showed brilliance at times whilst practising medicine in Melbourne, but all too soon he had involved himself in several disreputable incidents. Because of these his family disowned him. He was for a while on the Staff of the Victorian Benevolent Association and was found to be dosing his patients with morphia to keep them quiet whenever he felt like a few days off. He joined Howitt's expedition to search for Burke and Wills and apparently did nothing to blot his copy book.

However, the failure of McIntyre's expedition is to be attributed largely to Murray's gross misconduct.

On 27 March 1866 the *Age* published some correspondence which had appeared in the *Riverine Herald* on the preceding Saturday, 24 March. On 8 March a Mr George McGillivrey of Killara on the Upper Darling had written to say he had received a copy of the *Riverine Herald* in which he had found a letter from Dr Murray and the editor's comments upon it in a leading article. As the doctor had said McIntyre had made a faint attempt to find water and as the editor had appeared to be grasping at something near a proper view of the affair, Mr McGillivrey said he had no hesitation in sending the editor 'a verbatim copy' of a letter which he had received from Mr McIntyre and which would enlighten the editor on the subject of the disaster to the expedition. Mr McGillivrey stated he had always found Mr McIntyre to be a man of honor and a man who speaks the truth and he had no reason to doubt him in anything on this occasion. From Wilson's River on 17 December 1865 McIntyre had written —

I suppose you have been hearing news of the Leichhardt Search Expedition from time to time since

I left your quarter, and, no doubt, the last account has astonished you a little. The total loss of sixty six horses and the lives of ten men in danger, all in one day, is something quite new in exploring. I will, however, in as few words as possible, tell you all about it, as gathered from the evidence of the blacks and whites of the party, for I saw nothing of it myself. After leaving your place ... we arrived at the head of this river all right — 71 horses, 12 camels, 10 white men and 4 blacks. My brother, Anderson and Statue did not belong to the party; they came down to Bulloo from the Barcoo to see us start, and they intended to follow the Thompson (sic) up to where their cattle were ... We camped where there was an abundance of green grass, and water, for nearly a week. I then started out to look for water ... leaving Dr Murray in charge ... with instructions to move down the creek, if ... but not until the water was done. I returned the third day ... to move ... to a little water which I had found and which would have done for a few days ... I found that Dr Murray had sent the horses and camels six or eight miles down the creek ... although there was still water ... for three or four days longer. I was quite mad at this; all my plans were upset ... there was nothing for it but to take the whole expedition with me where ever I went as there was no use leaving anything in charge of ... Dr Murray; and bad as he was, he was the best I had to leave in any charge; and you know ... a person ... at the head of an exploring party ... often finds it necessary ... to go ahead and see ... (so as) not to risk the whole party at once ... on 25th November we all started for ... Cooper's Creek ... the distance being sixty six miles ... found the creek quite dry, and no certainty of getting water for 100 miles further ... The horses had been thirty six hours without water and the men about six hours. I then started to look for water and told the doctor to follow the tracks back to the last water ... finding water within ten miles of our former camp ... I immediately sent on fifty four quarts ... the main party reached the camp and the doctor ... lost all command of himself; he opened the brandy, got quite drunk himself, and made everyone else the same, and ... all went to sleep. About half the horses were unpacked, and the rest were left with their packs on. In the morning ... all ... were gone, packs and all. The doctor declared the expedition at an end, saying, "We may as well go the whole hog, boys; the Leichhardt expedition is ended". He again got quite drunk ... The end of it is—all lives saved, four horses only out of seventy one, all the camels, nearly half rations saved, all instruments saved; but to do all this I have travelled 600 miles within the last two weeks ... The expedition is far from being at an end. I have now M'Calman, Barnett, Belooch (East Indian) and two blacks ... with rations enough to take us to ... the North coast, and as soon as the camels are rested I will start on. Perhaps I am better — certainly safer — than before, for I am not depending on any one. Six years on the roads is too little for the doctor (McIntyre meant by this Murray deserved to be convicted and sentenced to this type of hard labour). The blacks proved themselves far better than the white men. Billy

saved the lives of four men when they were exposed to a glaring sun when in a state of helpless drunkenness. One of the black boys was ninety hours without water, and then was not so helpless as the doctor when twenty four hours without. Had it not been for the doctor and his confounded brandy all the men and sixty of the horses would have been into water in thirty hours or less ... I have found water about 25 miles NW from here ... and will remain there till the camels get all right. You need not show this to anybody as the less said about it the better. It will be all found in my journal when I return. You will, however, be able to tell anyone who contradicts what I have here stated that they are wrong. I have no doubt that the doctor will spread reports to my detriment, but if he does he may look out when I return. M'Donald and Gray will no doubt support him. They no doubt will say they were not drunk. The doctor acknowledged to having taken three quarters of a pint. They, at all events, finished six bottles between them ... I send this hurried note by private hand up the Barcoo. It may reach you some time, and it may not. I have no writing material, only these leaves of my note book.

It is obvious that McIntyre did not want hearsay reports about what happened at Coopers Creek to proliferate. He was looking forward to telling all the facts in person and damning Dr Murray beyond redemption. However, he realised he could be absent a long time and accordingly by way of a form of insurance placed his account of events in the hands of his friend McGillivrey so any mischievous reports to his detriment could be answered; and that is just what happened. In the following report the person making it has located Anderson with the wrong McIntyre initially. Certainly the coming of Donald McIntyre, Anderson and Statue to see the expedition off, as Duncan McIntyre says in his letter, could cause someone like Kruger to garble the tale and place Anderson with the expedition instead of merely visiting it.

Mr Kruger wrote to his brother Bernhard of Rutherglen, Victoria, about April 1866 to say that whilst on his way back from the Warrego River he had met and talked to a Mr Anderson. The latter said he had been looking for new country on the Paroo (Mitchell's Victoria) and hearing that McIntyre was on the road, he made up his mind to join him. He met McIntyre at the Bulla (Bulloo), a creek between the Paroo and Coopers Creek. Having seven horses of his own he succeeded in joining the expedition. The expedition moved on to a station occupied by a Dr Hutchinson (from the Ovens district in Victoria) where all going well they moved to a waterhole 35 miles away. From this was a journey of seventy five miles to the next waterhole on Coopers Creek. The whole party set out. All the animals were heavily laden and

suffered greatly, being three days without water. To McIntyre's great distress, on reaching Coopers Creek, it was found that the bed of the creek, eighteen months ago full of water, was now completely dry. There were only two courses of action open; to advance or retreat. The latter having been decided on, McIntyre with either Belooch or one of the aborigines (it is not clear which) returned with two camels in advance of the main party intending to rejoin it with a supply of water. Murray was to bring the rest of the party back to the last waterhole. McIntyre got to the waterhole, loaded up, and returned to meet them. Meantime this is what happened. Scarcely was McIntyre out of sight when Murray called a halt, and knife in hand ripped up the bags of flour, in which were concealed several bottles of brandy. All excepting Barnes (according to one report), or Anderson on his own say so, drank of the spirit until they were delirious and then fell into a drunken stupor. The fifty or sixty horses were abandoned *en masse* and wandered away with their packs and saddles on to die in agonies of thirst. Only three were saved.

Barnett says that it was owing to him that the calamities which happened were not far greater, for though he could not prevent what took place, he did prevent Dr Murray from serving the men with spirits of wine, which would, in all human probability, have occasioned loss of life.

Kruger said that McIntyre dismissed Murray and Gray, McDonald and Barnes elected to go with him. McIntyre was said to have given them one packhorse and one of the aborigines went with them as a guide ... They went first to Dr Hutchinson's station and after a three day rest went on to Charleville on the Warrego River (28).

It should be noted again that McIntyre says that Anderson had been with his brother Donald and neither of them were ever members of the expedition.

McIntyre's statement about Murray, bad as he was, being the best he had to leave in charge might seem to show a lack of confidence in Barnett. It must be remembered, however, Barnett held no office in the expedition, was in fact a supernumerary and finally he was only 24 years of age. His being placed in charge could have been resented by other members of the party.

Not unexpectedly Murray began excusing himself and accusing McIntyre for the debacle at Coopers Creek before he even got back to Melbourne. What had prompted George McGillivrey and the *Riverine Herald* to publish McIntyre's letter on 24 March 1866 was a letter

written by Murray from Wallumbilla in Queensland on 4 January 1866 to a Dr James which was first published in the *Bendigo Advertiser* and then on 7 February 1866 in the *Riverine Herald*. Murray infers that McIntyre had been rash in trying to reach Coopers Creek from Labrine Creek (Wilson River). Then he talks of McIntyre's 'faint effort' to examine Coopers Creek for waterholes. The retreat to the last water supply is covered, but there is no mention of brandy. All the Victorian portion of the party resolved to go no further. Three returned with Murray, but one remained with McIntyre (at his urgent request) until he could get another hand. The men of the party were obliged to resort to the most horrible expedients to quench their burning thirst.

The editor of the *Riverine Herald* felt this letter left many matters unexplained. The chief of these were whether Murray had left McIntyre to his fate and the circumstances surrounding the break-up of the expedition.

On 28 February 1866 the *Riverine Herald* published an account of an interview the *Bendigo Independent* had had with an experienced bushman recently returned to Sandhurst from the Wilson River (or Lubina (sic) Creek) in Queensland. This man said he had met returning members of the Leichhardt's Search Expedition; the circumstances relating to the break-up of the party were not at all creditable to those whom he had met.

When the *Riverine Herald* published McGillivrey's and McIntyre's letters on 24 March 1866 the editor in a scathing editorial soundly castigated Murray for his misconduct. In passing he expressed the opinion that it must be highly satisfactory to the friends of Mr Barnett, a son of Dr Barnett of Sandhurst and who had accompanied Mr McIntyre in his (earlier) gallant journey across the continent, to learn that Mr Barnett had remained true to his leader.

On 27 March 1866 Murray, by then in Melbourne, wrote a letter to the *Melbourne Herald* endeavouring to refute McIntyre's accusations. He said there was a very minute consumption of brandy (barely a quarter of a bottle) and it only had been consumed, in his case, to give him strength to work at unpacking the loads of the camels. The *Riverine Herald* republished this letter on 30 March and the editor again castigated Murray for his desertion of McIntyre and asked also why the Committee should wish to conceal the break-up of the expedition from the public.

On 29 March Murray wrote a further letter to the *Melbourne Herald*. He may have had help with

this as it is a much better written missive and facts are better marshalled than in his earlier letters. Murray denied his moving animals from where McIntyre had told him to keep them had caused undue delay (three hours only) in the moving off of the expedition. McIntyre was in a bad humour and his anger was responsible for him making rash moves. This letter was reprinted in the *Riverine Herald* on 4 April 1866 and accompanied by a copy of the editorial from the *Melbourne Leader*. This last expressed the opinion that it was a dreary and disgraceful story which had come to light. It had not been the 'correct thing' for Dr Murray to have consumed any brandy because of the demoralising effect his example had on the rest of the party. Had Mr McIntyre and the blacks also yielded to the fascinations of the bottle as the only possible source of strength, the expedition, if not the lives of the explorers, would have been brought to a ignominious end. The view was expressed that it was a pity the exposure had come before McIntyre's journal became available.

The *Riverine Herald* pointed out that McIntyre knew nothing of Murray's communications to newspapers. McGillivray and the *Riverine Herald* alone were responsible for the publication of McIntyre's letter and subsequent comments.

Murray's allusion to Barnett as the one Victorian who stayed with McIntyre only at his urgent request was an insult to Barnett. The *Riverine Herald* did not believe for one moment that Barnett required any urgent pressing, or pressing at all, to stay with his leader.

The fiery editorial concludes by accusing Murray of incapacity and cowardice. If Murray does not like this, he knows where to find his remedy. A classic example of 'sue and be damned to you'.

Despite the lambasting Murray was receiving he was claiming it was he who had saved the expedition and that McIntyre should never have been placed in charge of it. His persuasive powers were such that there were many people who believed him. Thus on 11 April 1866 'A Subscriber' wrote to the *Riverine Herald* expressing support for Murray as 'a man of high minded principles and upright character' and claiming that he had been made a scapegoat.

The *Riverine Herald* printed on 2 May 1866 an interview with a Mr McDonald who had just come in from the Wilson River. This is the Neil McDonald mentioned later with whom McIntyre was able to trade some surplus stores for four horses after the debacle at Cooper's Creek. McDonald corroborated what McIntyre had to say

about Murray and expressed his indignation at the efforts of Murray to attempt to 'throw the blame of his own cowardice and indiscretion on Mr McIntyre'. Murray had told McIntyre he would leave the country, which was the only reason McIntyre had not written to Melbourne 'anything that would compromise the doctor'. Neil McDonald also revealed that Murray, W.F. McDonald and Barnes had caroused all day while Gray, McCalman and Donald McIntyre laboured at unloading the camels and stacking stores. Then when the three last-named, worn out by their labours, were sleeping Murray and his two confederates had moved off with the camels leaving the three sleeping men to their fate. This confirms the need for Barnett to have carried Donald McIntyre behind him on his horse during the retreat from Cooper's Creek.

On 9 June 1866 the *Riverine Herald* printed an article from 'A Darling Correspondent' who reviewed the whole matter and concluded his summing up by saying

there was no disaster till after the brandy was drunk. There was nothing disastrous about having to turn back. The only disaster was the loss of horses and stores, and if Dr Murray had kept sober these could have been saved. Perhaps Dr Murray thinks his returning to Melbourne 'the disaster'. It was a pity that he ever left it, and I would advise him in the future to confine his explorations to the Richmond Paddock or Fitzroy Gardens.

Subsequently Murray turned his hand to blackbirding and became a partner in the recruiting ship *Carl*. After kidnapping 70 natives in September 1871 a further 80 Buka men were kidnapped and the ship was grossly overloaded. The main method of kidnapping was to run down fishing canoes and then seize the men left floundering in the water. The natives in the crowded hold started fighting. Murray panicked and he and the crew started firing into the packed hold. Seventy natives were killed or badly wounded. The latter, although still living were thrown overboard with the corpses. Murray escaped the gallows by turning Queen's evidence. A letter his father wrote which the *Sydney Morning Herald* published on 23 May 1873 is a truly remarkable document. It reads:

As regards Dr. Murray, the celebrated *Carl* mancatching approver, whom I have for years cut off as a disgrace to creed, country and family — your condemnation of that cruel, unhappy being I fully endorse and add, although opposed to capital punishment on principle, that if any of the *Carl* crew murderers ever ascend the gibbet for the seventy kidnapped and cruelly slaughtered poor Polynesians, Dr. Murray should be the first, as head. (29)

THE DEATH OF McINTYRE

So much for Dr Murray; but a fresh and final disaster awaited McIntyre. The wanton loss of stores at Coopers Creek, as a result of Murray's misconduct, led to certain replenishments being required before the remainder of the expedition set off for the western interior. From the base camp on the Gilliat River McIntyre went in to Burketown, towards the end of April 1866, to purchase the required stores. He could not have gone in at a worse time. It happened that in late March or early April the ship 'Margaret and Mary' sailed into Burketown with its crew mortally ill from unknown fever which had been caught in Java. The captain alone of the ship's crew survived. The fever, assuming plague proportions, swept the town. It was the wet season, the climate oppressive, there was a want of proper provisions and medicines, and resistance to the disease was low. In April 60 persons fell ill and in May and June 1866 there were 40 deaths out of a population of 90. Of the survivors there were few who had not suffered an attack of the "Gulf fever" as it came to be called. For a while it looked as though Burketown might have to be abandoned, but the fever ran its course and by 1868 it had cleared up and the town site was no longer regarded as unhealthy. (30)

Whilst McIntyre had camped about sixteen miles from Burketown, where he remained from 20 April to 4 May, he frequently visited the township on expedition business. He reported on 4 May that he was following rumours of a white man among the aborigines, but as previously revealed, on 23 May he fell ill with the Gulf fever while on his way to the base camp on the Gilliat River. There he died on 4 June 1866 and was buried on the east bank of a billabong by the Gilliat River. (31)

On 23 July 1866 Mueller released to the *Age* newspaper a communication from Mr John P. Sharkey, Queensland Crown Lands Commissioner for the Burke District with statements by Sloman and George Gracey as to the circumstances of McIntyre's death. Sharkey had written on 11 June. A sad fact emerges that although the expedition had a large medicine chest, McIntyre was unable to make use of it because all the labels were written in Latin. Having heard of this Sharkey set off for the camp on the Gilliat with some medicines which he thought might be of use, only to find on his arrival that McIntyre had died five days earlier.

The ladies of Melbourne sent a handsome gravestone, inscribed in both English and Gaelic, to be erected over McIntyre's grave. For many



FIG 4. Gravestone sent by the ladies of Melbourne to mark the resting place of Duncan McIntyre.

years it lay unnoticed on the beach at Thursday Island, whence it had been shipped from Melbourne en route to its final destination.

It was finally brought in via Normanton and erected over the grave by the billabong, seven miles away from Dalgongally Station. (Fig. 4). (32)

By the time Duncan McIntyre died Donald McIntyre, with 1000 head of cattle, had taken up a run on Julia Creek, which became the Dalgongally Station I have mentioned. Duncan McIntyre had examined this fine area in 1864 and had directed Donald to it. Donald was to remain in occupation of this run until his death in 1907.

BARNETT JOURNEYS TO BURKETOWN

On 17 September 1866 the *Age* published a letter which Barnett had sent to the *Riverine Herald* after his recent return to Victoria. He deals at length with the cowardice and villainy of Dr Murray. It is in this letter he first mentions what he repeated in his letter published in the *Argus* on 3 December 1867; namely he physically prevented Murray from serving out spirits of wine (i.e. absolute alcohol) to the party. He then covers the reorganisation of the party and the journey to the Gilliat River, about 150 miles south of Burketown. McIntyre expressed the intention of remaining there about a month to spell the camels and make up the deficiencies of the party. Barnett goes on to say —

... and I, with his consent, and I am happy to say a testimonial of his satisfaction of (sic) my conduct, left

the party, as he could now easily get a man in my place. I started for Burketown, and when I arrived J.G. McDonald, Esq., was just starting a boat party to endeavour to find the mouth of the Leichhardt River. I became one of the crew, and we were successful in finding the mouth only two miles east of Albert Heads (i.e. where the Albert River enters the Gulf of Carpentaria). We succeeded in getting up fifty miles to the crossing place, three miles below the falls, which are from fifty to sixty feet high, the water being under tidal influence below the falls. We returned to Burketown, Albert River, and I started overland for Port Denison, across the Flinders, the Norman, and the Gilbert, over the Gilbert Ranges, and on to the Lynd, down the Lynd and the Burdekin and thence to Port Denison. I think the Leichhardt navigable for about thirty miles. It possesses fine high banks, much to be preferred to the low mangrove fringed banks of the Albert. The Flinders, Leichhardt, and Albert and the tributaries are all pretty well settled, but there is still splendid pastoral country to the westward, and also there is some good country between the Flinders and the settlements on the Lynd. Respecting the half castes mentioned by Mr McIntyre, I can support his statement of their existence amongst the blacks about the country he speaks of. There can be no doubt of whites having been amongst them about ten or fifteen years ago, and it is likely enough there are still some. I think the northern country is likely to become as valuable to the miner as it is undoubtedly to the squatter.

Barnett had been released from the expedition on 24 March 1866. He received £35 wages, which were due to him. As it was necessary to conserve his funds he walked two hundred miles to Burketown, alone and unarmed at a time when armed horsemen made up parties of threes and fours for mutual protection. His eyesight was affected by ophthalmia, and semi-blind he travelled the last one hundred miles through the bush in three days without anything to eat. At no stage does he give a reason for leaving the expedition and any effort on my part to assign a reason could only be pure conjecture.

There is no doubt he was resilient, when so soon after his arrival in Burketown he took the opportunity to augment his funds by taking employment with J.G. McDonald. This man, with a small party, had visited the Plains of Promise in 1865. He discovered a more practicable route for cattle and sheep to the pastoral lands on the Flinders. He did not settle in the Gulf country, although he investigated much of that country. He had a run at Carpentaria Downs (nearly 400 kilometres ESE of the Gulf) and resided in the Lower Burdekin area. On the completion of McDonald's examination of the Leichhardt River Barnett was returned to Burketown as he says.

No steamer or other vessel being available at Burketown, nor the early arrival of one being anticipated, Barnett was forced to travel overland to Port Denison (Bowen). He took ship to Sydney. By this time having used up his small financial resources he was compelled to walk to Echuca in Victoria.

EVENTS AFTER MCINTYRE'S DEATH

After Duncan McIntyre's death, Dalgonally became the base for the expedition. Donald McIntyre appears to have exercised the role of field supervisor, but does not seem to have participated actively in the exploration. McCalman was joined by a Mr W.F. Sloman (to act as leader), Dr White, a medical man and G. Widish (sic — Wildish). Dr White had 'performed great exertions' to look after the fever stricken population of Burketown. Landsborough, who filled the dual roles of magistrate and crown lands commissioner there, spoke highly of the service Dr White had rendered. We learn also from a report from him that Dr White had not escaped the fever himself and that McCalman and Donald McIntyre also had suffered from it.

On 22 November 1866, over five months after Duncan McIntyre's death, Dr Mueller forwarded, with a letter to the editor of the *Age* at the wish of the ladies of the Leichhardt Search Committee a copy of the journal of the late Duncan McIntyre compiled by Mr. Sloman from the diary and field books of the lamented explorer, and very recently received through Donald Campbell, Esq., of Glengower.

The compiled journal adds little to what has been said already about the expedition up to the time of McIntyre's death. It confirms that Barnett joined the expedition on the Paroo on 10 September 1865. He had replaced a man named Steward. The Journal amply testifies what a valuable and useful part Barnett filled in the expedition.

It does reveal that Donald McIntyre was with the expedition until 4 December 1865. This substantiates Barnett's claim in the *Argus* of 3 December 1867 that for one whole day, during the retreat from Coopers Creek to the nearest water, he carried Donald McIntyre behind him on his horse with the result that the horse 'knocked up' and Barnett, himself, was compelled to walk many miles 'under the scorching sun, with fearful agonies of thirst' upon him.

Donald and Anderson left the expedition when Dr Murray, Gray, McDonald and Barnes did. According to this account the four last mentioned

were given two out of the three surviving horses to help them get back to the nearest centre; not just one as stated in Kruger's account. A reason is given for Duncan McIntyre electing not to go on with anyone else but McCalman, Barnett and Belooch. He said he had no means of taking them due to the loss of so many of the horses at Coopers Creek. Thus the disaster is glossed over and no blame is attributed to anyone.

On 26 March 1866 reference is made to Barnett having left the expedition. That his departure must have been without hard feelings on either side is confirmed, because he accompanied Duncan McIntyre and Welbo to the Flinders on 26 March and then parted company with them so he could carry on to Burketown.

Donald McIntyre must have wasted no time after leaving the expedition, because by 27 March 1866 the journal refers to his station on a waterhole (Dalgionally) near the River Gilliat and about three and a half miles north of Duncan's depot camp. He must have had little gratitude in his makeup in the light of his later treatment of Barnett.

McIntyre was able to make good some of his loss of horses in a small way on 16 December. A Mr Neil M'Donald who was in charge of some cattle and then camped on the Wilson River heard of the disaster from the returning party. He concluded McIntyre had more stores than he could take on without horses. He called at the camp at Safety Camp and offered on 9 December to exchange four horses for some of the surplus stores. The exchange was made on 16 December.

The journal was long and occupied several columns in the issues of the *Age* on 23, 24 and 26 November and 1 December 1866.

Dr Mueller carried his apologia even further for in the 1867 issue of *Justus Perthes Geographical Institute Bulletin* (*Mittheilungen aus Justus Perthes Geographischer Anstalt 1867*) edited by Dr A. Petermann and published at Gotha in Germany there appeared an article entitled 'McIntyre's Diary of his Journey from the Darling to the Gulf of Carpentaria 1865-1866' (McIntyre's 'Tagebuch Seiner Reise vom Darling zum Golf von Carpentaria, 1865 bis 1866M').

Much is made of the fact that although an expedition may fail in the eyes of the public if its initial goal is not reached, it has always great usefulness for the geographer, even if this is in areas not expected originally.

A number of examples are cited, but getting back to McIntyre it is said that although it had not been found what became of Leichhardt, yet

Geography has been rendered a priceless service, in that it has received a list of height measurements for

the first time of the relief of the large region between the Barcoo and the Gulf of Carpentaria ...

A short synopsis of the Course of the McIntyre expedition, along with detailed statements about its sad conclusion was carried in the previous issue of the *Geographical Bulletin* (pp. 365-368) [this would have been McIntyre's own account as set out in his incomplete letter of 2 May 1866 to Dr. Mueller], but since then Dr. Ferd. Mueller, whose efforts have largely given the expedition some standing, has published the diary left behind by McIntyre and edited for publication by his companion, Sloman. This diary was published in the *Age* (23rd. Nov., 1866 and following issues), so that we could reconstruct the route and record it on the map (Fig. 5).

The German article says no more than what was in the journal, published in the *Age* about what happened at Coopers Creek. McIntyre's version of the disaster to the expedition, published in the same newspaper on 27 March 1866 is blandly ignored by Dr Mueller in both the release to the *Age* and to the *German Geographical Bulletin*. Dr Mueller obviously would not have liked the full story to have been resurrected. Self-interest would have dictated this course, as well as chivalry towards the Ladies' Committee.

The matter having been put to rest in a 'decent' way, it was little wonder that Barnett, as will be seen, received short shrift when he advanced a claim for compensation in the latter part of 1867.

In the latter part of 1866 Sloman died suddenly from the combined effects of sunstroke and an organic disease of the heart, after having followed several of the Gulf Streams, but not succeeding in discovering any further traces of Leichhardt.

BARNETT AS LEADER

Barnett by then had been three weeks back in Victoria. He was requested by Donald Campbell to rejoin the expedition. Barnett was agreeable and returned to the depot camp at Julia Creek overland from Rockhampton, where he had arrived by steamer. Donald McIntyre then called on Barnett to assume command of the expedition. Letters from Barnett to the Ladies' Committee (dated 21 December 1866) and Donald McIntyre to Dr Mueller and Donald Campbell (dated, it seems, 22 December 1866) were taken by Belooch to Port Denison (Bowen) in the ship *Black Prince*. He left Julia Creek on 23 December and arrived at Port Denison on 11 January 1867. Belooch reported that the party were all well. A press item in the *Port Denison Times* of 12 January (copied in the *Australasian* on 23 February 1867) stated:

As to the party itself there appears to be some difficulty in obtaining a competent leader, and

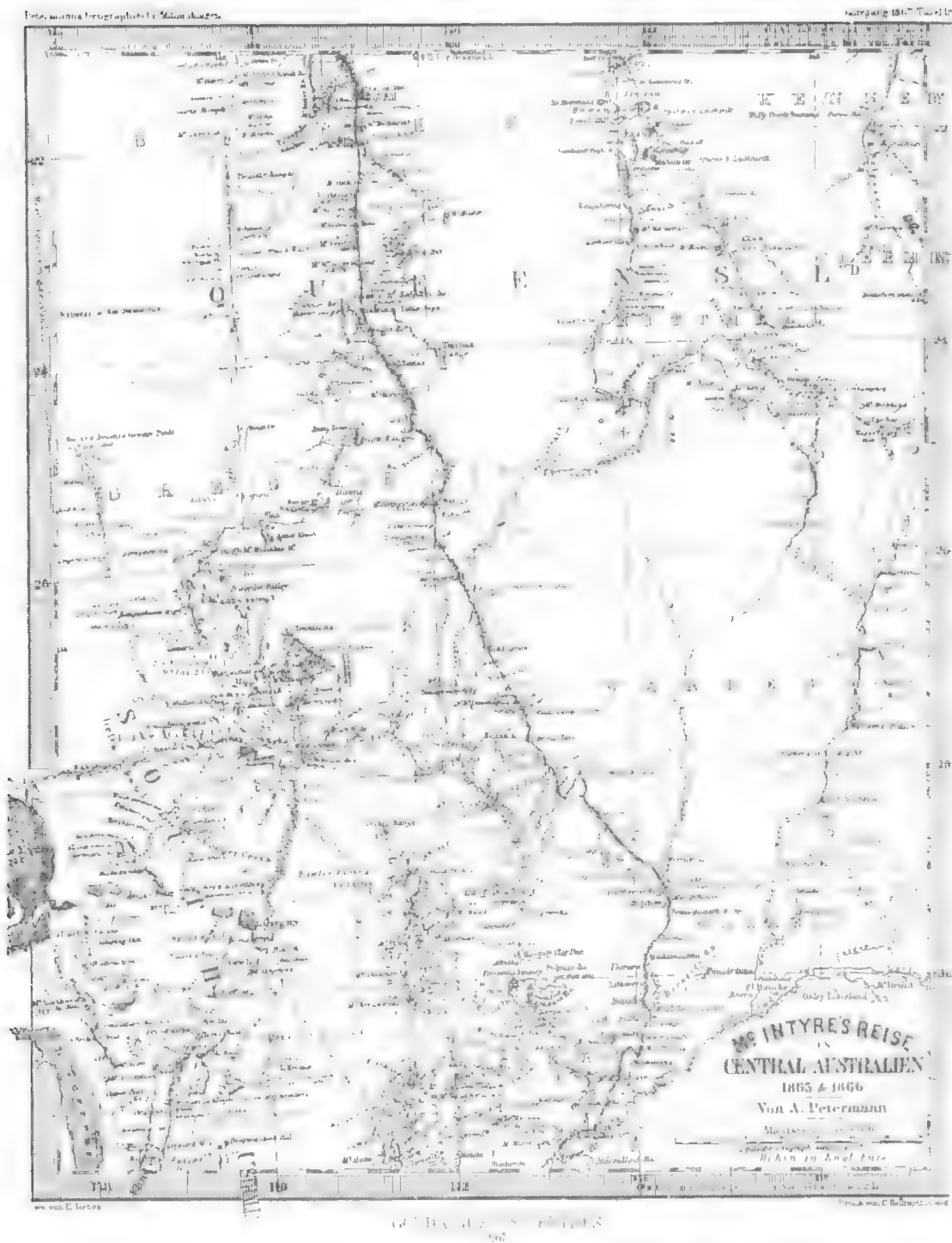


FIG 5. Map of the route taken by McIntyre published in the 1867 issue of *Justus Perthes Geographical Institute Bulletin*.

considerable dissatisfaction amongst the men in consequence thereof. We are inclined to hope that Mr. Christieson, of whose competency there can be no question ... will become the leader. Belooch has, we understand, sent telegrams to Dr. Mueller and the Ladies' Committee in Melbourne, and is awaiting the result. There are at present but three white men in camp, the whole party consisting of eight, the five who are not in camp being engaged in examining the surrounding country.

The *Port Denison Times* hopes for Mr Christieson were not fulfilled as the Ladies' Committee and Mr Donald Campbell confirmed the appointment of Barnett. (33) Before dealing with the final stages of the expedition under Barnett's leadership, some consideration should be given to the public feeling prevailing at the time he undertook the task.

An anti-McIntyre school of thought grew up in some quarters due to the vilifications of Dr Murray and statements such as that of Mr Kruger in his letter to his brother Bernhard:

He [Duncan McIntyre] purposely did not accept any salary from the committee in case any mishap should befall the party; he only looked out for himself. He afterwards selected a run on the Bulla, but, having no stockmen to put on, a Mr. Sullivan jumped it. When he found he had lost his run he pushed on to the Thomson River where he had no business to go, as his path and duty lies due north across the Thomson and on to the Barcoo, and up the Barcoo on the Flinders River, where he would come across Leichhardt's trail in 22 parallel, but never by going east into the settled districts. This is the second time that public money has been thrown away in such a shameful manner through bad management in not selecting proper leaders and men; it is no wonder people begin to drop to it, and will not give it more money.

... I am sure it is not the best way to get Leichhardt's trail — travelling through the settled districts of Victoria and New South Wales for 1,200 miles, wearing out man and beast to little or no purpose. (34)

A substantially similar letter appeared in a newspaper called the *M.A. Mail* from which it was reprinted by the *Riverine Herald* on 26 May 1866. It was claimed that Herman Kruger was a returned member of the Leichhardt Search Expedition. The *Riverine Herald* made short work of this claim, pointing out the only ones to return with Murray were McDonald, Gray and Barnes.

David Blair, in his *Cyclopaedia of Australia*, already referred to, says the expedition was an ignominious failure, the result of want of judgment and experience. Blair considered the marked trees on the Flinders were done by Landsborough, and the horses had been left by McKinlay.

Notwithstanding this McIntyre's honesty and bushcraft must have received more than a modicum of support when the provision and transport of the handsome gravestone by the Ladies' Committee is considered. Also Dr Mueller does not appear ever to have launched any criticism of McIntyre.

Perhaps Duncan McIntyre was one of those children of misfortune for whom any enterprise, once it commences to go wrong, despite all care taken and skill employed, can never be righted again. In his case the ultimate loss was his own life.

Nevertheless Barnett was to suffer from the ill feeling about the expedition which was prevalent.

BARNETT'S DIARY

Before presenting the text of Barnett's diary it is desirable that some anomalies should be cleared up. He refers to the Jenny River and William River of McKinlay. However, Barnett appears to have them in the wrong order; McKinlay finds and names the Jeannie (not the Jenny) on 30 April 1862 between his Camps 47 and 48. Then between Camps 48 and 49 on 1 May he discovered and named the William (35). Therefore the William must lie to the north of the Jeannie, but Barnett refers to them in the reverse order.

This has made even harder the preparation of a map of the area covered by the travels described in the diary. However, if the order of the William and the Jeannie is reversed it is possible to prepare a map which may describe the area traversed by Barnett and his party. McKinlay's meridians are not accurate. He is up to 20 miles out with some of his locations. Barnett does not give any latitudes let alone longitudes. However, his bearings are some help, but his failure to give a total mileage for every day makes it harder to truly delineate the route taken by his party and the area covered. Therefore the map (Fig. 6) must be regarded as largely conjectural. However, it does give an indication that the area searched could be circumscribed by latitudes 19°30'S to 21°S and longitudes 139°45'E to 141°30'E — 9500 square miles.

It should be noted that the party was beset by sickness — fevers and agues and in Barnett's case ophthalmia, which resulted in him having to be led by McCalman for some days as he was too blinded to see where he was going. Vagaries of weather also played a part in inhibiting the progress of the expedition. Excessive summer temperatures, thunder storms, flash floods and resultant boggiess of flat areas slowed down the transport

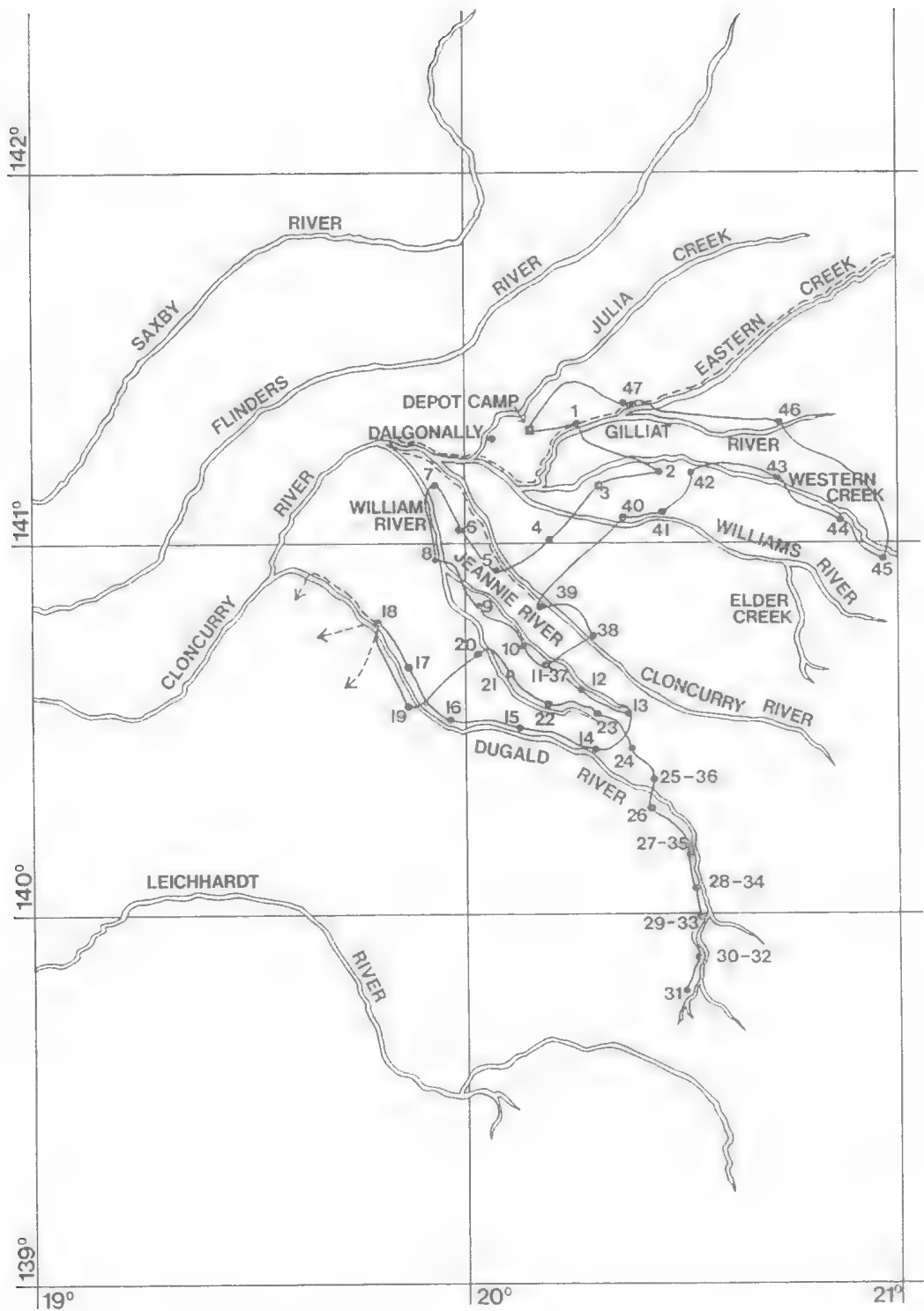


FIG 6. Map showing the conjectured search area.

animals (i.e. the camels) and limited the speed of exploration activities. An example of this occurred between 11 and 13 March 1867.

Barnett's camp identifications LE over a Roman numeral over B are to be interpreted as 'Leichhardt Expedition' followed by the number of the camp and then 'Barnett' as expedition leader.

Names of topographical features allocated by Barnett have not survived. The non-publication of his journal could account for this. The names never came into current usage, as, say, did those given to features by McKinlay which were published to the world at large in his journal and maps.

The diary commences on 20 January 1867, when Barnett describes the depot camp, the flora and fauna of the surrounding area and outlines what may be described as the guidelines of the expedition in its search for traces of Leichhardt. He details also the party personnel and the transport and stores logistics.

The diary now commences:
Sunday 20th January, 1867.

Depot Camp situated on a deep water-hole about 3 miles long and 100 yards wide in Julia Creek, an eastern tributary of the Gilliott which is a western tributary of the Flinders. The creek is only timbered here and there with small patches of scrub or a little worthless box; below the water-hole the creek runs out over low flat plains and above it, it becomes a very small creek occasionally breaking into several billibongs and then again forming large water holes. Its general course is E.S.E. and W.N.W.

The country on either side of the creek is a gently rising well grassed plain of dark loamy soil for about 2 mls when there is a slight sandy rise lightly timbered beyond which are gently swelling, well grassed undulations relieved by scrubby and lightly timbered sandy rises.

About 25 mls up the creek are several springs which cover many acres of ground the waters of which are slightly impregnated with soda, there are also two large springs of the same kind about 20 miles to the west of us situated near the Gilliott.

There was plenty of rain about a month ago so that the country is now looking its best and that is indeed beautiful. There is a fresh and wonderful exuberance of life. The whole country blooms in the magnificence of a tropical midsummer, creeping plants and many coloured flowers are plentiful over the plains which are covered with insects of every description.

The flies and mosquitoes are very numerous making the horses and camels very restless, many of whose eyes show the disagreeable effects of

these insects, two of the camels are quite blind in consequence of them.

There are several pelicans and ibis' on the water-hole together with numbers of water-hens, ducks and other aquatic birds.

Snakes, iguanas and lizards are very numerous in the adjacent country as well as flocks of Sturts flock pigeons.

The max. temp has been 111°F, in the shade but light zephyrs relieved the oppressive heat.

It is proposed that the party start tomorrow westward for these reasons "That all the other country has been well explored and most of it taken up by squatters who and whose men are continually riding over it and would most probably ere this have found traces of Leichardt did any exist. That, in consequence of the country becoming thus inhabited by white men the aboriginals have all receded to the west and to discover if any traces of Leichardt are amongst them we must follow. That if Leichardt arrived all safe at his marked tree on the Flinders, his most probable route would then or shortly after have been to the west, and that by thus travelling we shall cross all the western tributaries of the Flinders and on arriving at any one that has not hitherto been followed a camp may be formed and the creek searched both above and below our track and if possible communication established with the aboriginals, after leaving the water-shed of the Flinders all other rivers and creeks that may be meet with may be searched in like manner."

The party now consist of Wm. Fred Barnett (leader), J. McCalman (second in command) Dr. White (Medical officer) C. McIntyre, George Wildish and Myola (an aboriginal). We shall take with us all the camels consisting of 9 capable of bearing packs and 6 young ones, 10 horses and stores sufficient for 5 months.

Monday 21st January, 1867.

Started on a bearing of 230 over well grassed, gently swelling plains and in one hour and a half arrived at the middle creek, we continued on the same bearing over similar country crossing two flats subject to inundation and at 1.25 struck a blue bush flat below McIntyre Camp LII followed it up south for about a mile and arrived at the Camp I at 40 minutes past one. We travelled about 11 miles and found that the camels suffered very much being so fat and the young ones were a great nuisance. The camp is on a billybong of the Gilliott and there is very little water at it.

Large flocks of galars and cockatoos were flying about.

Tuesday 22nd January, 1867.

At 5 minutes past 8 on a bearing of 180 to avoid billybong and then 200 across the Gilliott, at 9.10 passed a spring Continued across creeks and billybong and to avoid water had to make more southey than desirable until about 12 o'clock when we struck over a low range running N.N.W. & S.S.E. beautifully grassed but covered with pudding stones. To the south the range is higher and thickly covered with gydia scrub. From the top of the range I observed about 2 mls W.S.W. a large belt scrub, over to the west a belt of timber which I believed to be a creek and I could see very high downs apparently on the other side. We arrived at the creek at 1.10 and camped on a billybong. There is not much water and as the rain appears not to have been so plentiful here I intend to go ahead tomorrow. We travelled 12 mls today. The max. temp has been 110°F. This country appears to be equal to any in the north as far as grazing capabilities are concerned and the creek we are now on most probably contains permanent water holes.

Wednesday 23rd January, 1867.

Leaving the party encamped at Camp II; which is branded $\frac{LE}{II}$ and B, I started with Mr. McCalman to examine the country to the west. We crossed several billybongs of the creek which has taken the name of Western, then over a fine high plain and in about a mile came on to a small channel sandy and the[n] crossed two sandy branches. We now could see a beautifully grassed rise before us the top of which is covered with patches of gydia scrub we continued in a west by north direction to the top of rise and could see that to the south by west it increased in height and the scrub became more dense, we observed a range running sou-west and nor-west about five miles distant. At about 4 mls from Camp II we arrived at a small dry creek running south which appears to continue into the range when it is thrown round into Western Creek. Continuing in a west by north course we crossed a small spinifex ridge and then for three miles over well grassed plains when we again came on to spinifex covered with decayed ant-hills and stunted apple leafed gums with occasional stunted bloodwood and bohemia trees. After travelling over this kind of country for about seven miles and seeing no prospect of a change ahead, we turned east and continued for 10 mls over similar desert country crossing several heads of the small creek we crossed in the morning when we came on to well grassed plains and gydia scrub and in five miles struck the Western Creek which

has here no sandy channel. We crossed it and followed it up three miles to camp It was my intention to have travelled west from Camp II but the country I have seen today causes me not to attempt it as the camels are in no condition for hard work. I shall therefore follow down this creek a few miles and then strike about NNW for the Cloncurry waters

Thursday 24th January, 1867.

Started at 8.20 a little to the east of north over well grassed plains which run back from the creek about three miles and then rise to a low well grassed range running nearly parallel with the creek timbered with patches of gydia scrub. On the opposite side of the creek there is a scrubby ridge running along within a mile. As we proceeded the plains became wider and dotted with small lagoons filled by shallow billybongs out of the creek. At 11 a.m. we crossed a billybong and camped at a good water hole in it as I see there is apparently a break in the scrubby ridge on the other side of the creek There is scarcely any defined channel in the creek here, it running in a broad flat cut up by small channels.

In the evening heavy rain clouds rose to the north and vivid lightning was observed in the same direction The max temp has been 115 F in the shade today Branded a tree LE

III
B

Friday 25th January

Started across the creek at 8 AM on a bearing of 330. Over break in range which open into well grassed stoney undulations intermixed with the patches of gydia scrub, Then crossed belts of gydia and well grassed stoney plains alternatively At 11 AM arrived at a spinifex ridge and followed down a small water course about same bearing to a blue bush swamp with water timbered with india-rubber trees. We made a little east to avoid swamp and then came through a small belt of gydia to a well grassed plain and in half a mile struck a branch of a large creek we can see farther to the north. The country travelled over today is very beautiful in appearance and if it proves to be well watered will be very valuable to squatters. I went over to the large creek and found that it is a large sandy channel in which there is at present water but it will not last long The timber consist of very fine gums and gum saplings together with box which runs back from the creek about half a mile on either side Heavy rain clouds are rising all round us and I observed a rainbow at 6 PM.

bearing 110. The max temp has been 116 today in the shade. Tree branded $\frac{LE}{IV}$
B

Saturday 26th January 1867

Started at 8.20 on a bearing of 340 over creek running south and in half an hour arrived at another running in a similar direction which we followed up into a creek coming from the west and running to the nor-east which I think the Cloncurry and the creek we followed up merely an anabranch of it We crossed the creek coming from the west and travelled in a north by west course through a box forest crossing two small billybongs running west by south. At length we arrived at a well grassed stoney rise lightly timbered with gydia and acaciae which we travelled up and crossed a little spinifex We struck the head of a small water course and followed it down to a blue-bush swamp and crossing a small gydia ridge arrived at a small creek running north. The max temp has been 117 F Toward sundown heavy rain clouds gathered to the N.S and E and about 8 PM there was a slight fall of rain Vivid lightning was observed to the S.W and N.E.

Sunday 27th January 1867

Camped. The day has been fine with gusty breezes Max temp 113F. Heavy rain clouds are gathering all round us At about 7 PM there was a smart fall of rain but having received warning we were all prepared having one tent over the stores and in the other we all managed to make ourselves comfortable.

Monday 28th January 1867

In consequence of the packs getting in disorder last night by reason of the rain we did not get started till 9 AM. After travelling for about a mile west over sandy ridges on which there was a sprinkling of spinifex, we came on to a blue bush swamp which contained water In order to avoid it we were obliged to make a little southing Continuing a little to the north of west we crossed a small dry creek running north and then passing through some gydia scrub in about two miles from camp came on to a small but very good creek running NNE in which there was large numbers of water-fowl of different descriptions and round the edge of the water heavy tracks of blacks We had to make to the east a little for a crossing, we then went through a belt of gydia and on to lightly timbered stoney undulations which soon became plains and then again undulations At 1.30 PM we

came on to a small creek with water timbered with gydia which we crossed bearing N We then proceeded for two miles over stoney well grassed undulations lightly timbered with blood wood and acacias and at past 2 PM, arrived at a small creek running about north timbered with box gydia and india-rubber trees called Whites Creek The max. temp. has been 115 and it threatens rain.

Tuesday 29th January 1867

Having made all snug last night we had scarcely turned in when it commenced to rain and continued until 1 AM this morning. During the storm a very fierce stroke of lightning struck close up followed by a most terrific peal of thunder The state of the ground and our blankets causes me to spell today.

Wednesday 30th January 1867

Started at about 8 O'clock across creek travelling west and to the north of it we passed through some gydia scrub and then on to stoney undulations with patches of scrub and acacias. Then over well grassed plain to a small water course running north and again plains to a small ridge timbered with acacias, Plains succeeded until $\frac{1}{4}$ past 10 we arrived at a creek running north generally running in a number of small billybongs but every few miles joining in a good water hole. We crossed the creek and a billybong of it and travelled over a rising plain on to high sandy flats timbered with blood-wood gums, box and acacias and covered thickly with portulac We found that the rain had been much heavier here and we made a very zig-zag way in order to avoid the boggy patches On arriving at a small creek running south about which there is a good deal of blue bush we camped at a water hole in it. The max temp has been 118 F and heavy white headed clouds foretold rain which commenced very heavily about 3 PM and continued till nearly sundown

Thursday 31st January 1867

The ground being too boggy for the camels to travel the party encamped. With McCalman, I started west and in about five miles travelling over country at first similar to that about the camp and then open plains. We came on to a small billybong which we crossed and in a few minutes came on to a very large dry sandy channel which I believe to be the William of McKinlay. We crossed it and in about a mile came on to a billybong containing water we then returned to camp It threatens more rain, anyhow we shall be compelled to continue in camp in consequence of the state of the plains

Friday 1st February 1867

The thermometer reached to 123°F and heavy rain clouds and thunder storms have been all round us today but the sky cleared towards the evening and the night was clear and starlight. The everlasting "parquil poker" of the frogs and the musical wheel-like click of the locusts are heard throughout the night.

Saturday 2nd February 1867

Started at half past 8 down the small creek on which we camped until we came to a crossing; we then travelled generally sou-west over lightly timbered sandy ridges and small plains. At 11 AM. we arrived at the William, in which now a small stream of water is flowing. The river possesses high banks timbered with gum box, cabbage palms and fig trees and a few small beef-wood trees. We followed up the river for about 3 miles passing a box flat and camped.

As Leichardt might have travelled on this river we shall follow it up and then if possible cross on to another water course farther west which we will follow down.

Sunday 3rd February, 1867.

Camped as Camp VIII. The day is fine and clear with a cool breeze from the sou-sou west

LE

Tree branded VIII

B

Monday 4th Feb 1867.

Travelling up the William a little to the east of south we passed several box flats and then on to the fine high banks of the river very well timbered. At about 3 mls a point of the river compelled us to make a little easting and then on our former bearing we passed over fine open well grassed glades with clumps of box running parrallel with them. Two miles brought us on the lightly, timbered sandy undulations and we then changed course to the west of south and in a short time came on to some small billybongs of the river. Observing a blacks signal fire bearing 225 we made for it and struck the river and continued up it until past 12 PM. Toward evening my head became very bad and I soon found I had an attack of fever but I must endeavour to get out of this camp tomorrow

LE

Tree branded IX

B

Tuesday 5th Feb 1867

Generally south up creek for about 3 mls when I noticed a good waterhole in the William and came on to some most beautiful country much higher than that we had been previously travelling over composed of well grassed stoney abrupt undulations amongst which various small creeks make their way and small plains of red loom magnificiently grassed and rich with herbage, relieved by clumps of gydia and acaciae. We crossed several small creeks and changing bearing to the west of south again struck the river and after following it up a short distance came on to a deep narrow channel coming from the east and camped

LE

Tree branded X

B

Wednesday 6th Feb 1867

Feeling too unwell to travel I desire Mr. McCalman to cross the river and examine the country about "He informs me that up the river it bears SW. There is a blood wood ridge running along about 2 mls back off the river and two dry broad shallow billybongs. About a mile up the creek on this side a billybong joins it containing some good water holes.

Thursday 7th Feb 1867.

I am still very weak and in much pain and consequently remain encamped

Friday 8th Feb 1867

Camped. The creek commenced rising towards evening and heavy clouds threatened rain. It commenced raining lightly about 10 PM.

Saturday 9th Feb 1867.

Heavy rain from 3 to 5 AM. The day has been very close and oppressive, the sky is dark and wild all round. By 12 noon the river had risen 9 ft. The rain recommenced heavily about sundown and continued throughout the night.

Sunday 10th Feb 1867

The day has been fine and the river commenced to fall rapidly

Monday 11th Feb 1867

Started with Mr. McCalman up billybong to river about 6 mls. It is very much broken here and the main channel bears a good deal to the west becoming broader and shallower. A small branch comes in from the south. On returning to camp Mr. McCalman started after the camels but was

unable to find one of the males for a considerable time At length falling in with some fresh blacks tracks he followed them and found that they had driven him into the river and very severely maltreated him They had only just left the camel when McCalman found him no doubt it was him who disturbed them This little incident shows that the blacks are both bold and hostile about here

Tuesday 12th Feb 1867

Started about SE to avoid the deep narrow channel of the creek running WNW and on striking it up where it is broken and timbered with gydia we crossed it and travelled over a well grassed plain to a good water hole in the billybong of the William. Colin McIntyre brought word that there are some tracks of cattle up the river — I intend tomorrow for Mr. McCalman to examine them and see if there is chance of getting a bullock and I will endeavour to overhaul the blacks.

LE

Branded tree XI

B

Wednesday 13th Febr 1867

Started with Myola down to Camp X and found there had been two blacks at it yesterday. We continued down the river and saw a great many fresh tracks of blacks After about nine miles travelling we arrived at a large camp where they had slept last night and about half a mile further came on to about ten men and a number of boys most of them busy gathering honey On perceiving us they all immediately precipitated themselves into the river and shortly disappeared not however until I had been able to show them that our camels were not to be maltreated with impunity. Having examined their camp and tools we returned to Camp XI.

Mr. McCalman informed me that the cattle tracks seen by Colin McIntyre were too old to lead him to expect cattle in the immediate vicinity

Thursday 14th February 1867

Encamped, shooting ducks

Friday 15th February 1867

Crossed billybong and proceeded up the river to where a deep creek joined it coming from the south, the river coming from the sou-west We then recrossed the billybong on which we camped last night, it coming out of the river just below the deep creek. The ground being very much cut up by deep narrow gutters we made out on the high downs on the east side of the river After five or six miles

travelling we crossed a creek timbered with gydia and box coming from the sou-sou east and I then observed two mounts one bearing 235 on the east side of the William and other bearing 260 which I have named after Mr. McCalman of the Expedition, I noticed these bearings at 11.6 AM: Bearing 260 for Mount McCalman over inferior plains. Over sandy soil timbered with Bloodwood, Bohemia and Apple leafed Gums at about 2 PM. struck the river which we crossed and camped. I proceeded 2 mls on a bearing of 260 to Mt. McCalman and observed another mount which I have called after the late Mr. W.F. Sloman

LE

Tree branded XII

■

Saturday 16th February 1867

Passing over sandy soil country timbered with Bohemia Bloodwood and Gums to hard stoney plains at three miles bearing 280 we made Mount Sloman which I ascended and observed a long heavy range about 25 mls distant the south end of which was bearing 290 which I will call McIntyre's Range after our much lamented and talented leader Duncan McIntyre, I likewise observed a mount bearing 320 to which we proceeded and camped on a small creek running east-nor-east which I afterwards found to be the Jenny

Sunday 17th February 1867

Camped.

LE

Tree branded XIII

■

Monday 18th February 1867

Leaving the party encamped I started with Dr. White on a general bearing of 290 over high broad stoney ridges, At 3 miles struck a creek which we ran down and found it rapidly increased in size running north and east, We travelled 280 over high stoney ridges to a small creek running N.N.E. Again over stoney ridges which soon became covered with quartz surfacing triodia and apple leafed Gums and passing over a quartz range we came on to a small creek. Crossing another Quartz range we came on to another small creek which we followed down until it meet the previous one on then we returned to Camp.

Tuesday 19th February 1867

Removed the party to a water-hole on the first creek I had struck yesterday and camped as it threatened heavy rain which luckily held off until

we had made all snug when it commenced heavily and continued for about 2 hours.

LE

Tree branded XIV

B

Wednesday 20 February 1867

Travelled with the party over the first quartz range and followed the creek down nth & nor-east with much difficulty the ranges coming in abruptly and travelling on the top of which was rendered almost impossible by deep gutters running at right angles into the creek. Having followed down the creek some distance we were able to cross and make on to the stoney ridge and follow down creek until we meet another coming from the sou-west which we crossed Continuing down creek we struck another from the west-sou west which was so deep and narrow and whose banks were so precipitious that we were compelled to follow it up some distance until it broke into several small ones which we crossed Finding travelling along the creek most difficult I struck over a timbered flat for a rock bearing 290 which I ascended and observing nothing but frightfully broken and scrubby country to the westward I changed bearing to 320 on to a quartz reef from which I observed small plains to the nor-east Changing bearing to 60 we continued over a timbered flat to a small plain, Seeing there was a water course on the other side I travelled east until we struck it but finding it a confused mass of deep gutters timbered with gydia I continued along plain a little to the east of north and observing the gydia lose itself in gum I made a little more easting and struck the creek, the heads of which we had crossed in the morning, which had now become a large sandy channel and which I believe to be the Dougall of McKinlay

LE

Tree branded XV

B

Thursday 21st February 1867

Travelling about nor-east down river we crossed it and continued down over high sandy soil country lightly timbered with Bloodwood Beef wood Box and Gydia to a Lime stone ridge which ran abruptly into the river. Travelling along a large plain we struck the river at Duncan McIntyre's XLV Camp of his first expedition to the Gulf, the camp at which he found the two horses.

LE

Tree branded XVI

B

Friday 22nd February 1867

Leaving the party encamped I with Mr. McCalman followed along the bank of the river and in two miles came on to a lime stone ridge on which is the grave of Davy, one of Mr. McIntyres black boys. There is a good water hole in the river here, We searched up and down the river and returned to camp

Saturday 23rd February 1867

Started at half past seven over sandy soil timbered with Bloodwood Beefwood Gums and Bohemias on to a large plain at 9 AM we struck a point of timber and in a mile cross a small billybong Over hard sandy soil lightly timbered with acaciae; crossed a sand ridge timbered with box and acaciae and then again on a hard sandy soil and small rich loom plains with occasional small timbered ridges Recrossed billybong and followed it down to Camp 17 I started west by north and in a mile pulled the river which I found had decreased in size and making much easting I followed it down three miles without seeing any water nor does its appearance promise any ahead

LE

Tree branded XVII

B

Sunday 24th February 1867

Camped. We shot a good many ducks, There are numbers of emus about this country and I forgot to mention that about the country we travelled over from the William to the Dougall kangaroos are plentiful

Monday 25th February 1867

Travelling about nor-east we passed over high lightly timbered plains and at a little more than a mile struck a large shallow water hole in billybong, Thence over well grassed plains entirely destitute of timber for three miles when they became lightly timbered and approaching the river the country became high and sandy timbered with box, gum and bohemias A large blue bush swamp compelled us to make a little to the east crossing a small billybong which we followed down along a sandridge passing two large recent camps of blacks. The billybong making in for the river we left it crossing the sandridge on to a low plain and in a mile and a half struck the river and camped as it had been raining a little and threatened more We had barely time to make all snug when we experienced such a wind storm that the pegs of our tent were torn from the ground and before we could set it again the rain came down as it were a sheet of water

Tuesday 26th February 1867

Crossed the Dougall to its west side on to long well grassed plains gradually rising for 2 miles to a broad rather stoney ridge bearing 30 down river along plains in four miles they became dotted with small clumps of gydia scrub with a line of gydia to the right fringing the river. Making a little more to the east the plains became lightly timbered with acaciae and in about a mile we came on to a billybong of the river timbered with box and india rubber trees and camped. It rained shortly after arriving in camp.

Wednesday 27th February 1867

The party encamped, Mr. McCalman and I started down the river and found that it is now cut up into many channels and has lost its former sandy nature its bed now being either quicksand or mud. The timber is principally box, gydia and india rubber trees with a few bohemias. On the west side a gydia creek comes from the ridge while on the east side is a high long plain well grassed. In the afternoon I crossed the river and followed it up over plains crossing which to the east I found them cut up by small water courses timbered here and there with box, I observed a number of turkeys and several native companions.

Thursday 28th February 1867

It having rained again yesterday the plains are too boggy for the camels we are therefore still camped, Mr. McCalman and McIntyre with Myola have started again down the river.

Friday 1st March 1867

Camped, Mr. McCalman and McIntyre up the river

Saturday 2nd March, 1867.

Rode over to creek on the west side of river, crossing which I entered a gydia scrub which was about two mls wide, Keeping a west course for seven miles over spinifex ridges crossing several small creeks which flow into the Dougall

Sunday 3rd March 1867

Camped at XIX. The river commenced to rise

Monday 4th March 1867

Steady rain with a reef-top-sail breeze from the sou-sou-west which in the afternoon became gusty and shifted to all points of the compass and the rain became heavier and continued until midnight

Tuesday 5th March 1867

A little rain in the morning, The country is in a frightfully boggy state.

Wednesday 6th March 1867

Rain again at 1 AM. Cleared towards daybreak Creek falling rapidly

Thursday 7th March 1867

Rode out in several directions to see if there was any chance of being able to travel but found the country in such a dreadfully boggy state that to attempt it would be useless. We had a few light showers in the evening

Friday 8th March 1867

The day promises to be fine. I, sincerely hope it may prove so, for being cooped up in this manner is anything but pleasant especially when such a short time has been allowed me

Saturday 9th March 1867

Fine during the day I rode over to the creek to the west and found it much flooded, managed to cross it and followed it about sou-west for five miles but could not find a crossing for the camels Travelling east I struck the Dougall and followed it down but could not find a crossing

Sunday 10th March 1867

Camped

Monday 11th March 1867

Finding it impossible to travel with the whole party on account of the boggy state of the country I determine to run down the river to find out into what it flows Accordingly started with Mr. McCalman across river with much difficulty and travelled down it about 15 miles general bearing 30. We now observed a spinifex ridge close in to the river on its west side and force it more to the east

Travelling on a bearing of 90 at five miles we had crossed several small channel of a water course which I believe to be the Jenny of McKinlay and then came on to a large water course having at this point besides billybongs two large sandy channels, the one being a billybong of the other This must be the William, Having crossed we followed down bearing 60 for five miles and camped on a small billybong

Tuesday 12th March 1867

On a bearing of 60 for six miles over well grassed plains Observing that the spinifex ridge on the west side of the Dougall appeared to force that river

close into the William we recross the William the Jenny and the Dougall and found their waters meet about here while their main channels run parallel with one another Having travelled about eight miles general bearing 25 we crossed the point of the spinifex ridge and observed to the east a large water course running north and south whose timber a little north of the point of the spinifex ridge joins the timber of the river we had just crossed This water course is the Cloncurry and Gilliott conjoined Bearing nearly north in about a mile and a half we came on to a camp of Mr Slomans situated about $\frac{1}{4}$ of a mile south of Mr. Palmers sheep station on a billybong of the Cloncurry and Gilliott conjoined. We now proceeded to return to Camp XIXB recrossing the William to its east side and travelled over at first small plains to a great extent flooded and cut up by anabranches and small creeks coming off the rising acaciae timbered plains running between the William and the Cloncurry Then high and rather stoney plains, well grassed and on to hard sandy country to the billybong on which we camped last night.

Wednesday 13th March 1867

Travelled over loomey plains on to the sandy bank of the William which we crossed and having passed over a similar sand bank and loomey plain on the west side we came on to high well grassed stoney undulations until we arrived at the Jenny. Having crossed the Jenny we passed over rankly grassed gently swelling plains until we struck the Dougall three miles below our XIX Ca — Camp We crossed the river with some difficulty and arriving at the camp found all right

Thursday 14th March 1867

Started out to endeavour to find a crossing on the river for the camels. Found good crossing on all the channels except the main one and over this I determine to make a bridge which was made accordingly The bed of the river being principally quicksand to attempt crossing the camels through it would greatly endanger them

Friday 15th March 1867

Crossed the Dougall to its east side and bearing a little to the south of west over well grassed plains in two miles crossed a west branch creek of the Jenny Two miles farther on the same bearing brought us to the Jenny which we crossed and observed the timber of the William about three miles to the east. We followed up the Jenny five miles over loomey plains covered with good grass

and herbage and camped on a billybong From Camp XX I rode across the Jenny to its west side, its billybong stretching over about a mile of country Having recrossed about a mile up I struck over the plain passing over a low stoney rise in three miles I struck the William and followed it down to a Black's camp where I noticed they had beds raised fully five foot off the ground. I saw the tracks of a great many blacks but could [not] see the blacks.

Saturday 16th March 1867

Travelling a little to the west of south up the Jenny at first over loomey plains and with good herbage Then over a gently sloping hard sandy soil rise which soon became broken with small loomey plains and cut up by small creeks At about 6 mls at a water hole in a small branch creek I observed some blacks, I rode up to them but they cleared out leaving their weapons etc behind them We camped at the water hole and I tracked the blacks about half a mile west to the Jenny. I followed up the Jenny about three miles south, It is timbered principally with box with a little gydia and india rubber trees Travelling east about two miles crossed on a bloodwood ridge the head of small creek which I followed down to Camp XXI. Mr. McCalman and I followed down the river a short distance crossing its billybongs on to the main channel I intend leaving the blacks weapons etc uninjured and shall also leave a small present for them in case they come back

Sunday 17th March 1867

Camped. No appearance of the blacks There are large numbers of corillas, pigeons and a good many whistling ducks about.

Monday 18th March 1867

Crossed the small branch creek on which we camped and continued up the Jenny over rankly grassed plains crossing here and there a low hard sandridge, spurs of the bloodwood ridge running parallel with Jenny After travelling about six miles the plains became very rotten covered with coarse herbage and grass At two miles farther we struck a billybong of the river and camped. During the afternoon I followed up the Jenny and found it came from the south for three quarters of a mile and then from the east by south for three quarters of a mile Continuing up it a mile farther over high sandy country timbered with blood wood bohemia and apple leafed gums (for the ridge that had been running about parrallel comes close into the Jenny here) I came on to a black's camp which they had

lately left but found nothing interesting Crossing the Jenny I travelled west about three miles over a well grassed plain which then gently rises to a ridge timbered with patches of gydia

Tuesday 19th March 1867

Crossed the plain on a bearing of 136 at one mile to the point where the Jenny and ridge are together and where there is a good water hole Then on a general bearing of 126 for 2 miles over sandy soil timbered with blood wood apple leafed gums and bohemia and dotted with decayed ant-hills Passing through about half a mile of gydia scrub we came on to a small plain and then again on to sandy timbered country Here and there where the soil is hard are a few shallow lagoons fringed with polygynum bushes on one of which we camped having travelled about nine miles After dinner I followed up the Jenny about five miles sou-west and saw a mount bearing 210 I then crossed the Jenny and followed down to camp The channel where we followed it up this morning was a deep and narrow but above the camp it became wider having good holes and several billybongs

Wednesday 20th March 1867

Travelling about sou west we passed over rotten sandy country timbered with large gums and crossed a branch creek coming strangely from the east nor east In two miles the country improves it being red soil with clay-pans, timbered with gydia and then a plain dotted with acaciae and gydia bushes While travelling over this plain I observed a mount bearing 210 and shortly after another bearing 225 Crossing two small branch creeks we camped on the west side of the second having travelled nearly 12 miles After a spell I followed round the ridge from east to nearly west crossing the heads of a number of small water courses running from the mounts which bear from a point 200 yds 240 from marked tree commencing east 165.190.205.225.247.262 and 275. Noticed an eclipse of the moon

Thursday 21 March 1867

Dr. White reporting Mr. Wildish not fit to travel in consequence of an attack of fever the party remain encamped. I crossed the Jenny to its west side and following the ridge struck it again at a point which bears 270 from camp and found it here a sandy well defined channel timbered with gums a stoney ridge timbered with gydia running close along side. The reason for my thus circling was that the Jenny has about here hardly any perceptible channel it spreading over a low plain subject to inundation tho' occasionally there is a

deep narrow gutter The number of small creek coming in also rendered it difficult to determine where the main channel came from Having found it I followed up and from its position description and its course where I left it believe that we shall find the head of the Jenny to be the small creek we camped upon after leaving the William There are innumerable Kyber about who seem to fancy a rather bare plain which much resembles a race course

Friday 22 March 1867

Mr. Wildish being no better the party remained encamped. Mr. McCalman, McIntyre and Myola crossed on to the William and struck it between Camp XI & XII After following it down on its west side for some distance they recrossed on to the Jenny striking it where I turned back on Wednesday afternoon to camp and followed it up to our present camp On returning Mr. McCalman complained of not feeling well during his ride and ere long he was compelled to lay up. Dr White reporting it to be a severe attack of fever

Saturday 23rd March 1867

Encamped in consequence of the sickness of Messrs McCalman and Wildish. I imagine they must have brought it from our 19th Camp where we hove to for the rain. I am glad to say. I should think this healthy country. Luckily both horses and camels seem to fancy our camp; most probably its being free from mosquitoes which were very troublesome down the rivers.

Sunday, 24th March 1867

Camped. The water not being good at the camp I have been in the habit of fetching it from a water hole in a billybong of the Jenny situated where it would be imprudent to camp as the country is flooded at times.

Mr. McIntyre when out after the camels found a good water hole the good water hole about a mile to the north of this; I went over to and finding a good camp close handy and the country round about high and dry, deem it advisable to shift over tomorrow, Dr White agreeing with me that this is the best to do and is of opinion it will be attended with no bad results to the patients

Monday 25th March 1867

Moved the party to a water hole in the Jenny about one mile north of Camp 24. The patients stood the journey bravely

Tuesday 26th March 1867

Camped at 25

Wednesday 27th March 1867

Followed up the Jenny to Camp XIII

Thursday 28th March 1867

The Dr reporting that the patients tho' doing well would not be able to travel for a week I thought it would be well for me to visit the depot camp and send a report of our progress to the Ladies. I therefore started at break of day and travelling a little to the north of west arrived at the depot camp at sundown having travelled about 60 miles

Friday 29 March 1867

Saturday 30 March 1867

Sunday 31 March 1867

} At the Depot Camp

Monday 1st April 1867

Taking a course to the southward of my journey to the depot camp I travelled back to the Jenny. When crossing the Cloncurry I observed a number of blacks the women scattered about collecting portulac When they noticed me they commenced howling like so many native dogs Being encumbered with a pack horse and the day drawing to a close I did not attempt to hold any communication with them. It was dark when I arrived at the Jenny and it being very troublesome riding I camped

Tuesday 2nd April 1867

Followed up Jenny a mile to Camp 25 and found all right, McCalman recovered and Wildish much improved

Wednesday 3rd April 1867

Getting packs in order for a start tomorrow

Thursday 4th Apr 1867

Crossed the Jenny and travelling four miles over lightly timbered stoney ridges we arrived at the Creek on which is situated C14 and camped not being sure of water until we arrived on the Dougall and that journey being too far for our invalid

Friday 5th April 1867

On a bearing of 300 over stoney well grassed ridges. At five miles arrived at sandy soil timbered with blood, bohemia and gums which continued for about a mile when crossing a small branch creek we struck the Dougall and crossed it. Following up the Dougall we crossed our track coming down it to camp 15. Passing over lightly timbered sandy country covered here and there with quartz surfacing and a great deal broken by

branch creeks Observed north end of range running S by E and N by W bearing 260; travelling for this as well as the country would allow we arrived at a small creek running south (a tributary of the Dougall) at which we camped, The end of range bears now 270 & another 180

Saturday 6th April 1867

Continuing up the Dougall our general course was 200; the range running parallel with the river to our right. The country is becoming very rough We crossed a spur of the range that came bluff into the river The best of our travelling was when we could follow the small sandy frontage of the river

Sunday 7th April 1867

Camped on the Dougall surrounded by mountains—I am suffering from a severe attack of ophthalmia and in consequence I must give up the leading of the party to Mr. McCalman tomorrow as I cannot see where I am going

Monday 8th April 1867

Continued up the Dougall being compelled by the roughness of the country to travel in its bed. The country is rapidly rising and low ranges come continually bluff into the river, where this happens there is a bar of blue rock across the river in which there are slight indications of copper. We managed with much difficulty to make six miles south and camped on a small sandy frontage of the river

Tuesday 9th April 1867

Travelling generally in the bed of the river we made about eight miles sou west. We could only camp in the sandy bed of the river as it would be difficult to find a level piece of ground large enough for a camel to sit down elsewhere. The camels and horses have to content themselves with the small green fringe on the river bank

Wednesday 10th April 1867

Continued nearly west up the bed of the Dougall, At half a mile from camp we passed a tributary coming from the north of west and at three miles entered a gorge where the bed is generally a blue rock and on either side the ranges come high and bluff on to the river Half a mile took us through the gorge and the high ranges then recede from the river tho' they can be seen coming in again ahead forming a kind of basin Having proceeded about three miles from the gorge we camped again on the sandy bed of the river, Mr. McCalman rode up the river and at one mile

from camp came to a perpendicular rise in the bed of the river of about four feet. Three miles further he came on another similar rise. He found the country on both sides of the river quite impassable for camels it being rocks of quartz, sharp iron stone ridges and parallel strata of slate standing on end with wondrous deep narrow crevices between them. He saw what he believed to be the main range about ten miles ahead.

Thursday 11th April 1867

From Mr. McCalman's description of the country and taking into consideration the state of the camels feet which have lately been getting very tender so much so that it is a question if I got on to the southern water-shed whether they would be able to come back without a spell of a month or two, moreover not knowing of any water I could depend upon for any length of time this side of Camp XXV together with my own blindness determines me to return and bearing in mind that the Ladies demand I shall always have a safe retreat.

Colin McIntyre prospected a small creek for gold and was successful in getting the colour, as it is called in gold diggers phraseology, twice but altogether I do not consider the prospect about here favourable for gold. Bar 29 5½ Ther 92F shade Midday.

Friday 12th April 1867

Followed down Dougall to gorge about three miles east by north. From the top of the range which come bluff in here a mountain being peculiar from its having one single tree growing on its top bears 45, A conical hill 64 A flat topped mountain 70, A mountain with a small sugar-loaf-like hill on the top 130 and a high conical hill in the basin above the gorge 195.

Saturday 13th April 1867

Passing through the gorge bearing generally north-east we left the bed of the river and crossing some stoney ridges we were lucky enough to fall in with a small strip of open stoney gydia which was much better travelling until we arrived at a creek timbered with box crossing which we were again on rough stoney ridges or sandy country with quartz surfacing and spinifex lightly timbered with stunted apple leafed gums and bloodwood until we arrived at Camp 29 which is now also 33.

Sunday 14th April 1867

Camped

Monday 15th April 1867

Bearing a little to the east of north and passing over very similar to that travelled yesterday we came to Camp 28 which now also 34.

Tuesday 16th April 1867

Followed along track to within one mile of Camp 27 and camped on a water hole in the Dougall. The north end of McIntyres Range bears 270 and is distant about four miles.

Wednesday 17th April 1867

Followed along track to Camp 25 which is now also Camp 36.

Thursday 18th April 1867

Crossed on to the William to Camp 12 but there being now no water we followed down our old track to Camp 11 which is now also Camp 37. I notice that although we were much put about by rain on the Dougall scarcely any has fallen on the country travelled to day since we passed over it before.

Friday 19th April 1867

Travelling a little to the south of east we passed over well grassed plains sometimes lightly timbered with acaciae. At four miles we arrived at a billybong of the Cloncurry and another mile over sandy soil timbered with blood and gums brought us to the river which we crossed, it being here a broad dry sandy channel. We followed down the river about three miles and camped.

Saturday 20th April 1867

Today we followed down the Cloncurry about three miles east and striking a deep creek from the south we recrossed the Cloncurry to get round it and camped on the west bank of the river.

Sunday 21st April 1867

Camped

Monday 22nd April 1867

Re-crossed the Cloncurry and travelling generally east passed over about six miles of desert country (hard sandy soil with decayed ant-hills and spinifex lightly timbered with stunted apple leafed gums and occasional blood and bohemian trees) alternatively with loomey plains and arrived at a box creek having a good frontage generally of about two miles in width on both sides. Crossing the creek and going over about five miles more of desert country we came on to gydia scrub and crossing a small creek travelled over four miles of desert country when we again came on to gydia.

scrub which continued for about three miles at times being so dense that we had great difficulty in getting the camels through it Keeping our easterly course we followed down a water course the gydia receding on either side, The water course seemed to lose itself on a plain and four miles from where we emerged from the gydia we struck the Western Creek and camped about four miles below Camp 3

Tuesday 23rd April 1867

Travelled up the Western Creek five miles over well grassed plains a good deal subject to inundation, In the afternoon Mr. McCalman with Myola started after a bullock to kill and returned at sundown with the bullock and two of Mr. Donald McIntyres black boys whom he had met being out for the same purpose

Wednesday 24th April 1867

Jerking meat, I wrote to Mr Donald McIntyre of our whereabouts and intentions and send the letter to him by his black boys

Thursday 25th April 1867

Camped at 41 jerking meat

Friday 26th April 1867

Camped at 41 Mr Donald McIntyre arrived

Saturday 27th April 1867

Dr. White started with Mr Donald McIntyre for that gentlemans station with instructions to return tomorrow as we make a fresh start on Monday

Sunday 28th April 1867

Camped—Dr. White returned from Mr McIntyre

Monday 29th April 1867

Travelling a little to the west of south up the west side of Western Creek for one mile when we crossed a tributary from the west Bearing then generally south in three miles we had crossed the Western Creek and its billybongs to the high well grassed plains on the east side Continuing the same course in four miles we arrived at Camp 2 and we camped on the creek about 500 yds 320 from that Camp

Tuesday 30th April 1867

Crossing on a bearing of 160 the billybong on which is situated Camp 2 we travelled five miles south over gently undulating plains well-grassed and with an abundance of herbage but all getting dry The country gets much higher as we proceed,

Camped on the east side of Western Creek and branded a tree LE

XLIII

B

Wednesday 1st May 1867

For about three miles we travelled a little to the east of south over high undulations covered to a great extent with lime stones and not possessing such good pasturage as the country passed over yesterday, Observing the creek was coming more from the west we changed bearing to the west of south After five miles travelling over similar country we struck a billybong of the creek and noticing the dry appearance of it we changed our bearing a little to the north of west to cross the creek and its billybong, At about one mile we arrived at the main channel and found it to be dry narrow sandy channel but we were encouraged to proceed but observing that blacks had lately been in the neighbourhood Desiring the party to halt, Mr McCalman Myola and myself started in search of water We soon found a large hole in a billybong with a small quantity of water but not considering it sufficient for us Mr McCalman crossed the creek to follow a western billybong whilst Myola and myself followed up an eastern one We shortly came on a large black's camp recently left and a large hole in the billybong with sufficient water. I started Myola to fetch up the camels but before they arrived Mr McCalman returned and informing me he had found good water in the western billybong when the camels came up we proceeded there, camped and branded a tree LE

XLIV

B

Thursday 2nd May 1867

The party remained encamped, Mr McCalman Myola and myself started up the west side of the creek on a general bearing of 270 The creek is a narrow dry channel timbered with box and gum and having a bed of quicksand On both sides there are good billybongs generally timbered with box or gydia.

Friday 3rd May 1867

Travelling generally west up the Western Creek over stoney well grassed undulations At four miles we passed some small lime stone hills of very picturesque description, Three miles farther we struck a billybong of the creek and camped From the high undulations running parallel with the creek on its west side the mountains are to be seen to the south and south east and the line of McIntyre's track running north

Further search should be made over the range on to the south western water shed but before we could arrive there the contract time would have expired and moreover the camels feet in consequence of their late trip in the mountains are so tender that it would be necessary to spell them some time before they would be fit for rough travelling Tree branded LE

XLV
B

Saturday 4th May 1867

Leaving the party encamped, I accompanied by Dr White started for the depot camp prior to bringing in the party

Sunday 5th May 1867

Leaving the Dr at the Depot Camp I returned to the party

Monday 6th May 1867

Travelling nor east generally over high well grassed undulations sometimes stoney principally country that has elsewhere been described in twenty miles we struck the Gilliott and camped

Tuesday 7 May 1867

Travelled 1 mile north and then nor nor east across the Gilliott and its billybongs and passing over a plain on the same bearing in three miles we arrived at the Eastern Creek. Over undulations for six miles and then we crossed the Middle Creek, six miles farther over similar country we arrived at the Depot Camp

Since our return to the Depot Camp Mr. McCalman and Myola followed up Eastern Creek over high downs for about 60 miles S.S.E. I with another horse party crossed to Camp 1 situated on the Gilliott and followed down that watercourse to its junction with the Cloncurry We then followed down these rivers conjoined on its east side to opposite the junction of the William, we then crossed the Cloncurry and followed it up to camp 39.

About the watercourses followed by the party I may mention that the Dougall is a large sandy channel timbered with large gums cabbage palms and teatrees having on its bank bohemian fig and bloodwood trees About our 18 Camp it breaks into a number of small channels and before long loses its sandy bed having one of loamy quicksand and loam and is timbered with box indiarubber trees & gydia which continue to its junction with the William

The Jenny is a small sandy channel timbered with from Camp 13 to Camp 25 when it breaks

into many channels, the beds becomes loamy and it is timbered with box and gydia & indiarubber trees to its junction with the William

The William is a large sandy channel timbered with large gums cabbage palms tea trees having on its banks bohemian fig and a few beef wood trees it retains its sandy bed & character to its junction with the Cloncurry & Gilliott (conjoined)

The Cloncurry is a similar channel rather larger

The Eastern Creek is a loamy channel having scarcely any timber; what there is, is a little worthless box

The Western Creek at Camp 45 has one channel timbered with box possessing a bed of loamy quicksand together with with good billybong it loses its sandy channel between Camp 2 & 3.

The Gilliott from Camp 1 to its junction with the Cloncurry is a creek of many channel principally timbered with box

The water courses mentioned are confluent streams but the junction of any does not increase the size of the recipient, the sandy channel near Palmers Sheep Station not being so large as either of the channels of the William the Cloncurry or the Dougall fifty miles up.

(sgd) Wm. Fred Barnett

Leader

27th May 1867.

The names of the William and Jeannie Rivers have not survived. Barnett speaks of the junction of the Dougall (sic) and the William, but it is hard to reconcile this with the text of the diary. The William appears to join the Cloncurry River south of where the Dugald joins it and not to be connected with the Dugald at all. If however the William is the Corella River of today, then it might be so.

The text of the diary has been left unaltered; for example the spelling of Leichhardt with one 'h' and a few other incorrect spellings. Also distances have been left in imperial measurements and temperatures in the fahrenheit scale.

It has not been sought to alter the punctuation, particularly in regard to the absence of full stops, but inadvertently some may have crept in.

On Saturday 16 February Barnett pays tribute to 'our much lamented and talented leader Duncan McIntyre'. He was a loyal soul.

On 28 March with Wildish and McCalman sick and unable to travel, Barnett rode in about 60 miles to the depot camp so he could send in a progress report to the Ladies' Committee. Another reference to the Ladies is on 11 April, where he says that they demand he shall always have a safe

retreat; that is to say he should not go beyond a point of no return. Lastly on 3 May he decided not to progress further to the southwest, as before he could arrive at the watershed the contract time would have expired. He did not seem to have any doubts about his accountability to the Ladies' Committee.

In the period between 7 and 27 May Barnett and McCalman examined the watercourses in the vicinity of the depot camp both to the north and the south, covering several hundred miles in the process.

The final result was that no further traces of Leichhardt were to be found in the area of the search. The expedition was at an end.

FATE'S LAST BLOWS

Once the expedition was officially terminated Barnett began to find out who really were his friends and supporters.

In the first place when acceding to Donald Campbell's request to return to Carpentaria, Barnett understood that his ultimate appointment was to rest with Donald McIntyre in Dalgonally.

However, his consent to go back was on the following conditions:

- (i) In the event of his not taking charge of the party, he should receive his expenses to Carpentaria and back to Victoria, with fair remuneration for his loss of time; but
- (ii) If he was appointed leader he was to be paid his expenses 'going and returning' and the compensation for his services, although left an open question until his return, was to be 'ample and satisfactory'.

Barnett arrived at the depot camp on 29 November 1866. Donald McIntyre was absent and did not return until 22 December, when he acquiesced in the appointment of Barnett as leader.

On Barnett's return with the party to the depot camp on 7 May 1867 he received a letter from Dr Mueller requesting him to continue the expedition for a longer period than that which had been contracted for. With this request he could not comply as Donald McIntyre was not agreeable.

On Barnett requesting Donald McIntyre to give him £50 to pay his expenses to Victoria this request was refused. McIntyre told Barnett he would pay him only from the time he was appointed (22 December 1866) at the rate of £200 per annum.

Also, and this was, perhaps, the unkindest cut of all, McIntyre said that he supposed Barnett 'had come over, like any other man, for the job'. He then proceeded to debit Barnett £25 for a horse

and £10 for tobacco for which Barnett had chosen not to charge the members of the party considering they were entitled to be supplied with that item. As a result Barnett was left with £37.15s. He had to borrow £12.5s from McIntyre, for which he had to give his note of hand, to enable him to get back to Victoria.

On his return to Melbourne Barnett immediately visited Donald Campbell and requested a settlement. Campbell told him he could do nothing until he had seen the Ladies' Committee, but at Barnett's request advanced him £20. Campbell asked Barnett to call on Dr Mueller, but the doctor was too unwell to see him. However, Mueller sent a message to Barnett to call on Mrs Tierney, the honorary secretary of the Ladies' Committee, who told Barnett that the ladies had nothing to do with Mr Campbell's arrangements.

Barnett saw Campbell again; the latter said that any moneys paid would be out of his own pocket and he could not think of giving Barnett more than £25, which, with the £20 already advanced, would pay his expenses from Carpentaria. That was all Barnett received.

He had returned to the family home at Rowan Street, Sandhurst. From there he wrote on 12 August 1867 to the Ladies' Committee seeking a just settlement, as he had failed to receive one from Donald Campbell and Donald McIntyre on whose honour he had relied. Mrs Tierney responded on 20 August. She said she would place his letter before the next meeting of the committee in mid-September, but did not think that it would interfere in any monetary transaction between Messrs. Campbell and Barnett.

After some procrastination on the part of the ladies, they, in a letter (18 October 1867) signed by Mrs Tierney told Barnett they could not entertain his claim as they had contracted out the management of the expedition to Donald Campbell, who alone was responsible to Barnett. In any event the ladies no longer had any funds at their disposal.

Barnett's gullibility seems to have stemmed from his hero worship of Duncan McIntyre. Campbell and Donald McIntyre would have known of the admiration he had for Duncan and seem to have taken advantage of this. Barnett does not appear to have been informed until after the expedition was completed and he had returned to Victoria that the ladies had contracted out the balance of the expedition to Donald Campbell. He seems to have been under the impression that Campbell and Donald McIntyre were acting as advisors to the ladies, whereas they were in fact sub-contractors who had taken over the

responsibility of the ladies' committee towards the expedition and its members. Obviously they did not want to lose money from their contract. The ladies were remiss also in that when confirming his appointment as leader of the remainder of the expedition they did not tell Barnett that he was not their financial responsibility.

On 21 September 1867 Mr Thomas Dicker of St. Kilda wrote to the *Argus* about circumstances which had recently come to his knowledge through an acquaintanceship with the family of the late Dr Barnett (Adolphus had died on 14 February 1867 aged 54 years). (36)

Dicker, after setting out the terms of Barnett's appointment as already related, strongly put forward Barnett's claims and enclosed all the correspondence between him and the ladies. He also made the point that any reports sent in by Barnett had been 'suppressed'.

When publishing the correspondence the *Argus* added an editorial note saying all the correspondence had been received some weeks before, but had been held over in consequence of Dr Mueller being absent at King George Sound. As a result of the holdover Barnett's letter of 1 October to the ladies requesting a reply to his earlier letters and the ladies' reply of 18 October, already referred to, were published as well. (37)

The day after Dicker's letter with all enclosures was published a lengthy letter from Dr Mueller appeared. The doctor reiterated that the Ladies' Committee had entered into an agreement with Duncan McIntyre for a two year search for Leichhardt. Before a year elapsed McIntyre was dead of fever in an area not previously known to be unhealthy. Mr Sloman, who was unknown to the committee, but McIntyre's appointee as second in command, then became leader of the party, but died soon after from sunstroke in the vicinity of Burketown, an area where traces of Leichhardt were not likely to be found. The Ladies' Committee, to keep faith with supporters, decided to keep the search party in the field for the remainder of the two years. They contracted out to Mr Donald Campbell of Glengower the balance of the time. It was Campbell's sole responsibility that Barnett was entrusted with the leadership for the remaining time and this arrangement met with the concurrence of Donald McIntyre who, from his Gulf Station, supervised the expedition. Mueller says Sloman's post easily could have been filled before Barnett ever arrived at Carpentaria. By reason of the contract process the Ladies' Committee had no responsibility, monetary or otherwise, towards any member of the party. They

felt on the other hand they were entitled to some real field work during the winter of 1867 to compensate for all the delays at the Gulf camps. They had hoped for an examination of all the Gulf rivers and not merely some eastern waters. There had been deep disappointment when the search party returned after 'two months of easy travel'. The reports from an area so limited and already so well known were documents so devoid of importance that it would have been unfair to have sought newspaper space for them. Mueller had kept them so that they might be used in some final report, but would recommend now that they be returned.

Dr Mueller asserted that the ladies had dealt most generously with the contracting gentlemen. Thus the severe loss 60 horses resulting from an incautious but very courageous movement during an extended drought, a movement over which the committee had no control and which ruined the expedition, nevertheless resulted in a £500 supplement of the contract sum being granted.

The doctor lamented that after two years exertions of the ladies, 'maintained bravely under great difficulties and discouragements', their operations were now being made the subject of public controversy. He promised a full accounting of the expedition expenditure would be made to the public.

He also expressed anxiety that the ill-starred enterprise might become the topic of public discussion to an extent which could discourage reorganisation of the expedition, seeing that the camels were now available at Carpentaria. This would subdue a chivalrous spirit for exploration and, above all, poor Leichhardt again would be abandoned to his fate. (38)

Dicker had said:

It would almost appear that mismanagement and blundering are fated to attend every exploring expedition equipped from this colony of Victoria the proposition to enlist the services of a leader in Victoria for such an expedition and then to offer to pay him off in that heartless huckstering fashion at one of the ends of the earth is certainly as preposterous as one can well conceive. But this does not appear to be the only point on which the management of the expedition had blundered. Mr. Barnett recopied Mr. Slowman's (sic) journal and forwarded it to head quarters— that has been suppressed. On another occasion he rode in seventy miles to send a report; and on a third occasion, on the return of the expedition to the depot, he journeyed 130 miles in three days to catch the Burdekin mail to forward another report, both of which reports were also suppressed.

.. It might be said of Dr Mueller's letter, in which he sought to reply to Dicker's allegations,

that he did protest too much and was inclined to fog clear-cut issues with emotive statements.

The *Argus* seems to have had his measure, though; in a leading article on the following Friday it was said that the correspondence published on the previous Monday (Dicker with enclosures) and Tuesday (Mueller) showed, if it did nothing else, the relative value attached by some people to a live Englishman and a dead German. The leader writer traversed the whole sorry story. He praised Barnett's courage and endurance:

they seem to indicate that Mr. Barnett is made of the right stuff, and possesses the hardihood and endurance so essential to success in the work of exploration.

He went on to say that the laying of the affair before the public had resulted in a reply from Dr Mueller, but not a confutation. The doctor seemed to be of the opinion that Barnett was fortunate that the leadership of the expedition, with its munificent stipend, was not filled up before Barnett could arrive at Carpentaria. The doctor was taken to task for deprecating the labours of the search party (as 'two months easy travel'), suppressing the journals forwarded to him and not allowing the newspaper editors to form their own opinions as to their worth. As regards the £500 so generously awarded to the contractor for the loss of sixty horses, might not a similar sympathetic feeling have been extended to the leader who brought back his party intact, whose sight was irreparably injured by the hardships he had undergone and who was incapacitated from obtaining any employment in consequence?

The *Argus* no less than Dr Mueller had a genuine anxiety about the fate of 'poor Leichhardt', but it also felt some anxiety for the health and safety of living men and for the just recompense of those who had already engaged in the search for Leichhardt.

The leading article concluded on a note of inquiry —

We are far from agreeing with the Government Botanist, "that this ill-starred enterprise should not become the topic of public discussion", because it is only by such discussion that the public are likely to arrive at a satisfactory conclusion as to the wisdom and propriety of persevering in these disastrous expeditions. The time is arriving when we should ask ourselves this question — Is it expedient to continue explorations of which other colonies reap the solid advantages, and from which we obtain nothing but barren honour? At the sacrifice of their own lives, and at an enormous cost to Victoria, Burke and Wills opened up a tract of magnificent country from Cooper's Creek to the Gulf of Carpentaria. It was

shortly afterwards incorporated with Queensland, and is now being rapidly occupied by the squatters of that colony. We pull the chestnuts out of the fire, and they eat them; and we may reasonably ask ourselves whether we cannot find more profitable employment for our surplus cash and superfluous energies. (39)

This was hardly conducive to the encouragement of further searches being mounted for Leichhardt and no doubt thoroughly mortified Dr Mueller. However, he had been less than pragmatic in his approach to the whole Leichhardt Search Expedition and its aftermath and was not undeserving of the criticisms levelled by Dicker and the *Argus*.

W.E.P. Giles wrote from Mount Murchison on 23 December 1867 deploring the implied accusation that the affairs of the expedition had been mismanaged by Dr Mueller. He felt if Dr Mueller accused Mr Barnett of having failed in his duties, the doctor would have good grounds for so doing, or he would not have made the accusation. Mr Giles, 'as a personal friend' of Dr Mueller requested the publication of this letter,

especially as I know, and doubtless you are as well aware, that since the committee first agreed with Mr. McIntyre, Dr. Mueller's self-imposed duties with regard to the expedition have produced to him no mental sinecure. (40)

Giles, on his own admission, was hardly an unbiased commentator!

As is not unusual, the sound and the fury seem to have died down after each protagonist had had his say. No record can be found, after Giles' letter to the *Australasian*, of any other reference to the controversy in any other 1868 newspaper. There is no evidence that Barnett gained any pecuniary satisfaction, although his honour and his leadership capabilities had been defended by the *Argus*. He is not on record as having undertaken any further journeys of exploration; no doubt his health prevented that.

Barnett, in his twenties, was an unsettled type of person. His dislike of a desk job was made obvious in his letter to his Aunt Eliza Newman in 1864. The outdoor life seemed to suit him. Yet he had to assume the role of a knight errant. The combination of idealism and naivete made him fair game for the dour, hard headed entrepreneurism of the McIntyres and Campbells of this world. He ruined his health and his economic prospects because of his loyalty to Duncan McIntyre, both before and after the latter's death. Barnett's disregard for his own material interests in comparison with honour and devotion make him a quixotic figure in the

immediate aftermath of the expedition; his tilting at windmills was no more successful than that of Don Quixote.

On 19 October 1869 at St. Lukes Church of England, Emerald Hill, South Melbourne, at the age of 28 years he married Charlotte Harris (a widow since 22 January 1868) aged 32 years. The bride was the mother of three surviving children, a fourth having died before her second marriage. Mrs Harris was a licensed victualler and like her bridegroom normally resided at Sandhurst. Barnett gave his occupation as 'explorer', but he roamed no more. (41)

He settled down as landlord of the Crown Hotel, Hargreaves Street, Bendigo (as Sandhurst now came to be called). His privations between 1864 and 1867 continued to tell on his health. The delicate boy may have grown into the hardy backwoodsman, but even the latter had limits to the extent to which he could punish his body with poor diet, untreated fevers, eye disease and alternately roasting and steaming in the unrelenting climate of the lands below the Gulf of Carpentaria.

A combination of liver disease (acute hepatitis) and epilepsy carried him off, at the age of 37 years, on 18 March 1879 and he was buried at Back Creek Cemetery, Bendigo on 19 March. (Fig. 7). It will be noted that under his name on the tombstone the words '(late explorer)' appear.

He was survived by his widow and two of the three children of their marriage. The third had predeceased him in her infancy. The remaining two

children were both daughters, so he left no male issue. (42)

His obituary recounted his exploring trips and quoting from a *Riverine Herald* report (43) on the end result of the Leichhardt Search Expedition said:

We believe that a greater mistake was never made by any leader [Duncan McIntyre]. Had Mr. Barnett been given a command, the frightful disaster at Cooper's Creek might have been averted. At all events it was due to his exertions in a great measure that worse results did not follow. (44)

Among those who knew him his reputation was not diminished by death; his judgment again was vindicated by contemporary opinion, but the recognition he deserved still eluded him.

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- (11) *Australasian* (Melb.) 31 December 1864.
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- (13) *Age* (Melb.) 23 December 1864, *Australasian* 31 December 1864.
- (14) *Australasian* 18 February 1865.
- (15) *Australasian* 4 March 1865.
- (16) *Australasian* 15 April 1865. Leichhardt, Dr. Ludwig. 'Journal of an Overland Expedition in Australia' (London 1847) p. xiv *et passim*.
- (17) *Australasian* 27 May 1865.



FIG 7. The tombstone of William Frederic Barnett in the Back Creek Cemetery, Bendigo. Under his name appear the words '(late explorer)'.



FIG 8. In December 1986 Mr. K.C. Leslie received an addition to the Corfield papers from Epsom in Surrey, which included some more Barnett material. One of the photographs, undated and simply marked *Australia* on the reverse, shows what is obviously an exploring party. The second European from the right resembles closely the photograph of Duncan McIntyre. The young man on his right, holding a camel halter, could be Barnett who was the most junior member of the party. Lacking positive evidence the identification of any person in the photograph must be treated as pure conjecture.

- (18) Reprinted in the *Australasian* 6 May 1865.
- (19) *Australasian* 27 May 1865.
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- (21) *Australasian* 1 July 1865.
- (22) *Australasian* 8 July 1865.
- (23) *Australasian* 5 August 1865.
- (24) Queensland State Archives (QSA) Gov/24 p. 333. Despatch 52 8/8/1865.
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- (26) Age 30 May 1866, *The Weekly Herald* (Brisbane) 9 June 1866.
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- (40) *Australasian* 11 January 1868.
- (41) *Government Statist*, Victoria Marriage Entry 3603/1869.
- (42) *Government Statist*, Victoria Death Entry 2971/1879.
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ACKNOWLEDGEMENTS

That I was able to complete this paper to something approaching my own satisfaction was due to the help of a number of people.

First of all, Dr W.E. Savige of Camberwell, Victoria, who carried out research for me and who investigated W.F. Barnett successfully from the somewhat sparse details I was able to give him.

It was Dr Savige who put me in touch with Mr. D.K. Muir of Balgowlah, N.S.W., who has been researching the Barnett family for his friend, Mr K.C. Leslie, Education Officer at the West Sussex Records Office, Chichester, England and a Barnett

descendant. As a result I had put at my disposal the Barnett family tree compiled by Mr Muir with much other information. This included the copy of the invaluable letter from Barnett to his aunt, Eliza Newman, which Mr Leslie kindly gave permission to be used. Mr. Leslie also furnished the interesting photograph reproduced here as Fig. 8.

The Director and staff of the Queensland Museum and the State Librarian, New South Wales and his Mitchell Librarian and staff all endeavoured to find the provenance of the W.F.

Barnett diary, held by the Queensland Museum, which provided the basis for this paper.

The John Oxley Librarian made a valuable contribution, when, by chance, he purchased a map showing McIntyre's route from the Darling to the Gilliatt River. From notations on this we found it had been torn out of a copy of Justus Perthes Geographical Bulletin for 1867 and this in turn led me to the relevant issues of the *Age* in which McIntyre's posthumously compiled and edited journal had appeared.

My thanks are extended to all of them.

COMMUNITY PATTERNS REVEALED BY TRAWLING IN THE INTER-REEF REGIONS OF THE GREAT BARRIER REEF

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ABSTRACT

Several series of exploratory trawls on and adjacent to the Great Barrier Reef produced approximately 15,000 specimens of fish and macro-invertebrates representing some 700 species. Classification and ordination analyses of the catch from the principal trawl series made over easily trawlable grounds showed no clearly definable community assemblages — rather a gross continuum with a tendency to depth discrimination — a discrimination revealed most sharply by the fishes. More rigorous sampling in a smaller area, but including 'foul ground', reinforced this depth related patterning (again most evident from the fishes) which, in turn, correlated well with sediment type and distance from shore. This study supports others which suggest the trawlable regions of the tropical continental shelf may be biologically separable into few continua. Complete faunal/station lists are given.

INTRODUCTION

Despite extensive commercial trawling activity along the Queensland coast we have a relatively poor knowledge of the animal assemblages that inhabit trawlable areas. From September 1979 to May 1982 several series of trawls were conducted by both Commonwealth and State Fisheries to explore for new trawl areas, especially in the more difficult inter-reef regions. Although not designed to systematically sample the Queensland shelf, the trawls did produce a great quantity of demersal and macrobenthic animals which were made available to the Queensland Museum. This paper attempts to interpret and summarize these data.

Although Frankel (1978) listed some 4500 citations for the Great Barrier Reef Region, most of these relate to the coral environs. Literature dealing with the structure of the trawl fish community and its distribution in this geographical area is limited to Kailola and Wilson (1978) and Watson (1984) for the Gulf of Papua, Liu (1976), Lui, Lai and Yeh (1978) and Lee (1979) for the northern Gulf of Carpentaria, and Rainer and Munro (1982) for the southern Gulf of Carpentaria.

Our trawl data are for the Great Barrier Reef Region especially between Cape York Peninsula and Townsville and our intention was to determine the nature and limits of the assemblages or of community types that occupy the trawlable soft-bottom environment between coral reefs.

Differences in collection methods and data handling techniques has meant that final analyses were limited to subsets of the original material.

Available data suggest that commercial trawling beyond the established trawl zones in inter-reef areas of the Great Barrier Reef Region currently is quite limited, but increasing as a result of economic pressures on the large, coastal prawn-trawl fishery (Hundloe, 1985). It can be assumed, therefore, that the data sets for such areas are descriptive of the original unexploited demersal communities and thus have considerable value as base-line information from which longer term management decisions can be formulated.

Rainer and Munro (1982) confined their study to fishes and cephalopods, both relatively easy to identify and highly mobile within the environment. This study included most macrofauna collected by the trawls, viz. fish, echinoderms, crustacea, molluscs, cnidarians and sponges. While trawling undoubtedly may not be the favoured collection technique to sample all these groups most effectively, in practical terms trawling does yield large quantities of all the groups mentioned. We included the six major groups (but excluded 'minor' groups such as ascidians, bryozoans and various worm groups) because we believed that they were likely to increase the resolution of community types and because they seemed most likely to show the effects of increased trawling effort in the future.

STUDY AREA

The Great Barrier Reef Region is a vast area of diverse and complex geological and hydrological features (Maxwell, 1968) dominated by coral reefs and lying along the Queensland coast north from approximately 25°S. To the north the Region tends to disperse through the Torres Strait (9°S–11°S) and merge with the huge coastal estuaries of the Papuan Gulf. To the west of the Torres Strait the Region merges with the Gulf of Carpentaria which is an expansive shallow gulf with relatively little hydrographic variation (Munro, 1972) and an almost complete lack of coral reefs.

Seven series of trawls (0 through VI) were undertaken in the Great Barrier Reef Region (Fig. 1). While the vast majority of these trawls were completed on the soft-bottom inter-reef areas of the continental shelf, most of the Series III trawls were on the continental slope. A summary of station data for each trawl series including dates, locations, depths and bottom characteristics is presented in Appendix I.

METHODS

From February 1979 to May 1982 a total of 229 sites in seven series of trawls were sampled; more than 15,000 specimens representing approximately 700 species were obtained. Because the rationale of each trawl series varied, there has been corresponding variation in the methods of obtaining and handling the biological material that forms the basis of these analyses.

Biological Data — Trawled material was generally frozen in bulk aboard the survey vessel. The frozen samples were then returned to the laboratory and thawed, where practicable in preservative, and sorted to phylum. These preserved specimens were transported to the Queensland Museum for identification. Species were identified from available literature. In many cases (especially for the lower groups) identification to the species level could not be determined with confidence because the fauna is in need of considerable taxonomic research. Where names could not be applied, and more than one species was believed present, they were listed as spp. Every attempt has been made to make names and classifications follow the most current available literature. Appendix II gives a checklist of the fauna related to stations.

Physical Data — Only physical data relating to depth and some subjective classifications of bottom type derived from the trawl logs are presented (see Appendix I). Other data were inconsistently gathered or reported. Sediment

carbonate content was derived from Maxwell (1968).

Data Analysis — No attempt was made to analyse all the data because of the disparate nature in which they were collected. Two series (I and V), however, were analysed. In the larger (series I) data set only binary (presence, absence) data were collected. The series V cruise was made specifically to investigate potential patterning and numerical data were obtained.

Stephenson (1973) summarized the earlier attempts to understand and quantify the nature of marine benthic communities or assemblages. Community analysis in recent times has commonly used either ordination or classification techniques. These strategies are not considered mutually exclusive (McIntosh, 1967) and can be gainfully combined in a single analysis (Lambert and Dale, 1964).

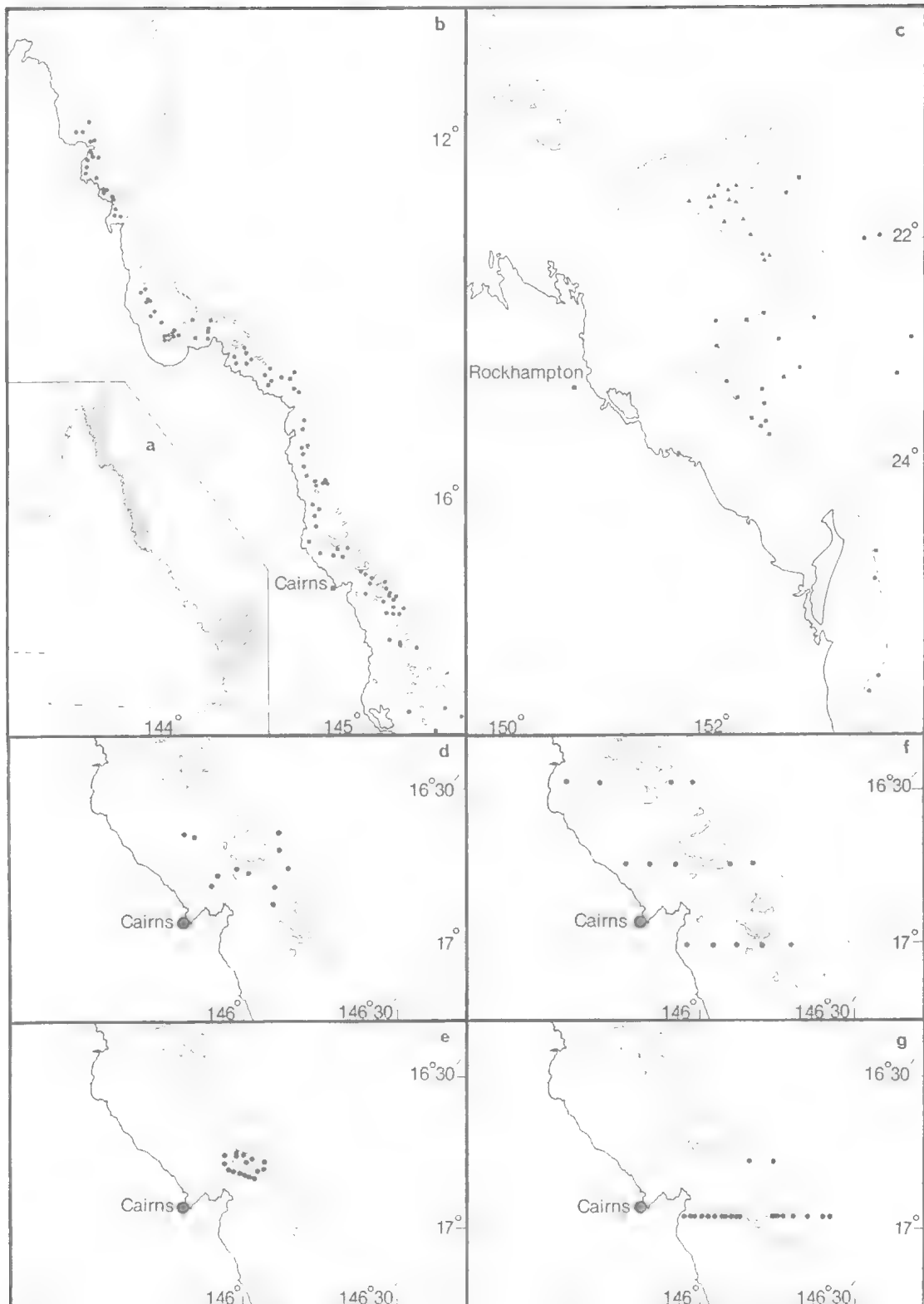
Ordination techniques attempt to reduce data dimensionally while retaining maximum information on inter-entity relationships. At least in marine benthic work, however, classification has been more commonly employed in community analysis (e.g. Rainer and Munro, 1982). It places entities in classes based upon shared attributes.

In the present study both ordination and classification were used in interpreting results by highlighting complementary facets of the data patterns. In particular the ordinations allowed interpretation of the classificatory dendrograms by providing a means of observing group overlap.

The analyses made use of the TAXON programme package (CSIRO computer network). We used the Canberra metric dissimilarity measure to generate the classifications and as input into the principal coordinate analysis used for ordinations. For classification the 'flexible' sorting strategy of Lance and Williams (1967) was used. This follows the successful precedents of Stephenson and Williams (1971), Williams and Stephenson (1973) and Stephenson, Williams and Cook (1974). The 'cluster intensity coefficient', Beta, was set at -0.25 which means it is a slightly space dilating strategy less likely to show 'chaining' tendencies. In addition we employed the Cramer measure to provide an insight into which attributes (i.e.

FIG 1. Locality of trawls.

- a. Distribution of trawl series along Queensland coast.
- b. Series I stations
- c. Series II (▲) and III (●) stations
- d. Series 0 stations
- e. Series IV stations
- f. Series V stations
- g. Series VI stations



species) contributed most significantly to the determination of classificatory groups (Lance and Williams, 1977).

In series I, apart from a small group of stations in Princess Charlotte Bay where large nets were deployed, material was collected with a commercial 'try' net, i.e. one with only a 2m gape. Quantitative measures were not obtained, thus analyses were confined to binary attributes. The large number of species (>700), many of which were rare occurrences, suggested truncation of the data set; thus single species and/or site occurrences were eliminated. We restricted the data set further by analysing attributes at both the family and genus level separately rather than at the species level (which was used only for the fish). This served several purposes; it eliminated some of the taxonomic uncertainty, it increased the coarseness of the analysis to one more in keeping with the area surveyed and measures used in collecting while retaining biological reality and, not insignificantly, it greatly simplified the data matrix.

In series V the small 'try' nets were again used, but numerical counts of the species were made. These data were analysed by the same methods; because of the relatively small area and greater rigor of the trawling procedure there was no truncation of the data. Before analysis, this data set was transformed (square root) in an attempt to normalise the data.

The other trawl series were not analysed because we felt the disparity in collection methods precluded useful conclusions. Series 0 trawls which gave some very preliminary results from simple statistical tests were undertaken as a ancillary to trials of underwater video gear (Goeden and Cannon, 1980). Series II were designed specifically to investigate scallop grounds, III were conducted with large fish trawls in deep water towards the edge of the continental shelf, IV were specifically to search for Crown-of-Thorns starfish and VI employed both main gear trawls and a small dredge in a exercise to trial a new boat and its gear. The station species lists are included in Appendix II, however, for they may be considered to fulfill a useful role in their own right.

RESULTS

TRAWL SERIES I

PRIMARY ANALYSIS

Initially analyses were directed at the six major groups; Fish, Echinodermata, Crustacea, Mollusca, Cnidaria and Porifera.

Family Level

When analysed at the family level the classificatory programme generated ten clusters, but the level at which these clusters were discriminated suggests only three biologically valid (meaningful) groups (Figure 2a):

I A, B, C, D, E

II F, G, H

III I, J

Of these three groups none showed any strong correlations with the abiotic factors geographic position or bottom type, but depth did show a weak influence. From examination of the Cramer discrimination values, the invertebrates showed strongly in group I (Echinoderms: Comasteridae, Laganidae) and fish in groups II (Leiognathidae) and III (Bothidae). The ordination analysis (Figure 2b) showed sites grouped by the classification were not discretely differentiated, but rather the site groups overlapped strongly. The family most strongly influencing the ordination was the Penaeidae (prawns) found predominantly in one of the subgroups of group II. This particular subgroup corresponded to collection sites in Princess Charlotte Bay. The families influencing the ordination positively included the fish families Leiognathidae, Hemipteridae, Scorpaenidae and Apogonidae. In contrast, the echinoderm families: Comasteridae, Temnopleuridae and Goniasteridae were inversely associated with the pattern. Thus these data produce no convincing patterns.

Genus Level

The classificatory programme was run a second time on the six major groups using taxa at the generic level. Once again ten clusters were formed which were best discriminated again into three groups (Fig 2c):

I A, B, C, D

II E, F, G, H, I

III J

In two groups, we found the genera *Minous* (Scorpaenidae: Fish), *Amusium* (Pectinidae: Mollusca), *Leiognathus* (Leiognathidae: Fish), *Nemipterus* (Nemipteridae: Fish) and *Comatula* (Comasteridae: Echinoderm) were the most influential taxa, being relatively well presented in group II, but not, or poorly in group I, i.e., in group I invertebrates dominated and in group II fish dominated. The ordination of site groups determined at the generic level (Fig. 2c), although overlapping in some cases, differed from those found at the family level. The major exception to

this was again the strong isolation of the Princess Charlotte Bay sites (Group III).

Both analyses of the six major groups produced a similar pattern: an invertebrate rich group of sites and one rich in fish, plus the Princess Charlotte Bay sites. The composition of the groups, however, differed in the two analyses.

SECONDARY ANALYSIS

Both analyses involving all the groups implied that taxa in the groups Mollusca, Cnidaria and Porifera had little effect upon the classification. The data set was therefore restricted to Fish, Echinodermata and Crustacea i.e., removing all sedentary sponges and cnidarians and also the molluscs — predominately animals living in the sediments. Although such fauna is collected by trawls, they are perhaps more ably sampled by other techniques.

Family Level

The classification at the family level (Fig. 3a) created four groups, one of which containing only 2 stations was considered inconsequential (Group IV/J). The important groups were:

- I A,B,C,D,E,F — rich in all three groups of organisms and including a subset from Princess Charlotte Bay,
- II G — with some crustacea, but generally poor in fauna, and
- III H,I — rich in fish and echinoderms, but relatively poor in crustacea.

The ordination of these data did not produce any clearly defined axes of variation. This lack of strong pattern was emphasized by the diffuse spread of the classification site groups over the major ordination axes (Fig. 3b).

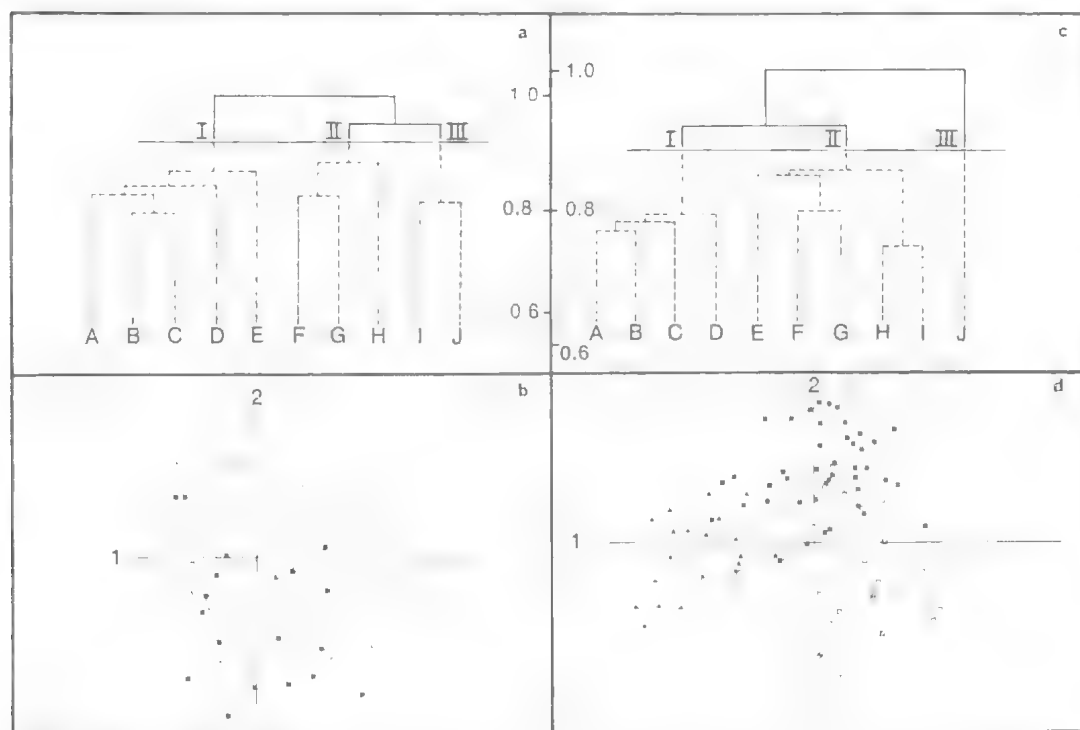


FIG 2. Analysis of sites from series I (Fish, Echinoderms, Crustacea, Molluscs, Porifera and Cnidaria).

- a. Classification — Family level
- b. Ordination — Family level
I = Δ , II = \circ , III = \blacksquare . (Groups from 2a).
- c. Classification — Genus level
- d. Ordination — Genus level
I = \blacksquare , II = \square , III = \blacktriangle . (Groups from 2c).

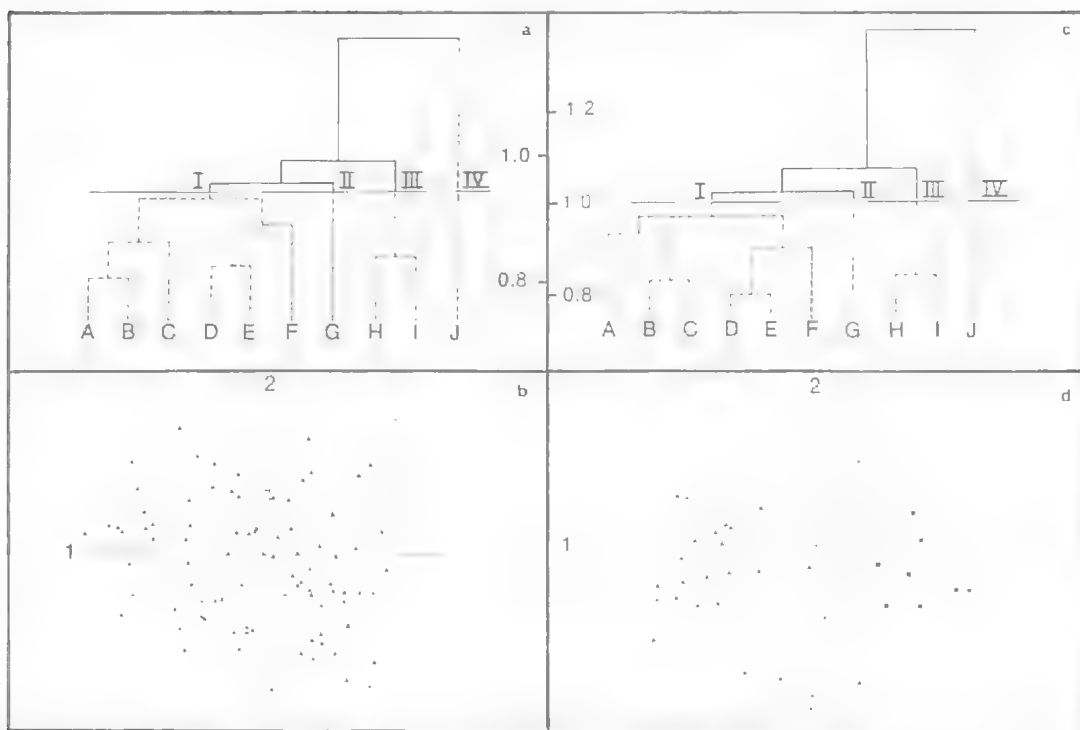


FIG 3. Analysis of sites from series I (Fish, Echinoderms and Crustacea). Group IV points have been omitted as insignificant.

- a. Classification — Family level
 b. Ordination — Family level
 I = ▲, II = △, III = □, (Groups from 3a).
 c. Classification — Genus level
 d. Ordination — Genus level
 I = ○, II = ■, III = ▲. (Groups from 3c).

Genus Level

In Fig. 3c we see some chaining of the site groups occurs at the generic level. Ignoring the clearly aberrant group (IV/J) we again see three groups:
 I A,B,C,D,E,F — rich in some genera of crustaceans and echinoderms,
 II G — a small group containing *Saurida* and *Comatula* and
 III H,I — a large group rich in crustacea and fish (this group includes the Princess Charlotte Bay sites among others).

Once again ordination of these data (Fig. 3d) revealed overlapping groups and, as occurred when all groups were considered, it was not easy to directly relate the analyses to one another. Certainly the Princess Charlotte Bay sites were discriminated, but overall analyses of the series I trawls using higher taxonomic levels failed to reveal discrete assemblages and, at best, presented only a weak depth related pattern.

TERTIARY ANALYSIS

In all the analyses so far presented fish appeared to be the most influential taxa in determining what separations did occur. Thus a further analysis of the fish alone was performed and at the species level.

Species Level

Fig. 4a shows the pattern of the classification with four groups revealed:

- I A — A group of shallow water sites largely from Princess Charlotte Bay. The most significant representative fish were *Psettodes erumei*, *Saurida tumbil* and *Pseudorhombus elevatus*.
 II B,C,D, and E — Also a cluster of shallow sites lacking the above species but characterised by *Engyprosopon grandisquamma*.
 III F and G — A number of slightly deeper sites with the fish *Euristhmus elongatus* and *Arnoglossus* spp.

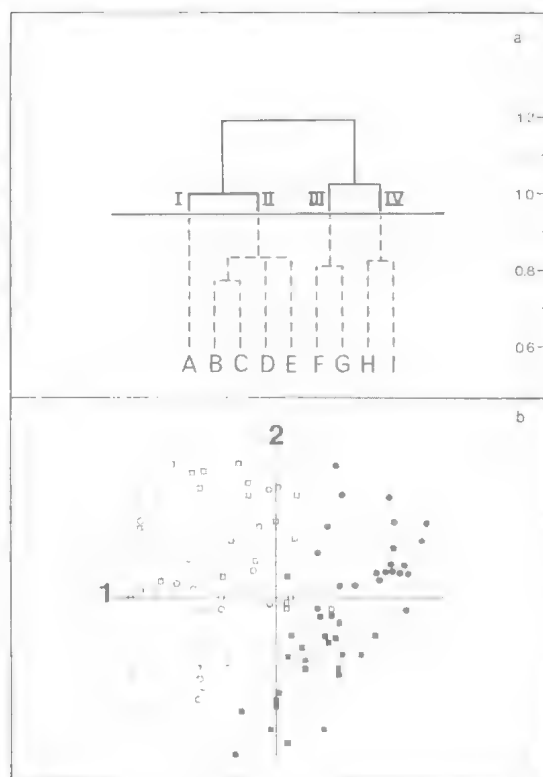


FIG 4. Analysis of sites from series I (Fish only)

a. Classification — Species level

b. Ordination — Species level

I = ●, II = ■, III = ○, IV = □.
(Groups from 4a)

IV H and I — Also deeper sites, though lacking the *Arnoglossus* spp. they did have *Pristotis (Daya) jerdoni*.

An examination of the Cramer values revealed that sites in groups I and II were discriminated by *Pomadasys* spp. while those of groups III and IV had several influential fish species, viz. *Pseudorhombus elevatus*, *P. diplospilus*, *Grammatobothus polyophthalmus* and *Paramonocanthus* sp.

The ordination analysis (Fig. 4b) reinforces the separation of four groups and emphasises the similarity of I with II and III with IV. Indeed, compared with the earlier analyses, the overlap of sites between site groups is not at all marked. The most influential species in this analysis were as follows:

Group I *Pomadasys argyreus*, *Nemipterus* sp., *Upeneus sundiacus*.

Group II *Apogon fasciata* and *Rogadius* sp.

Group III *Pseudorhombus* spp., *Saurida undosquamis* and *Grammatobothus polyophthalmus*.

Group IV again *Apogon fasciata*.

The mean depth of the groups I and II was 25.7m while that of III and IV was 35.5m. This analysis showed more clearly that a separation related to depth (or distance from shore) was apparent. These presence/absence data reveal that distinctions were based often on the absence of certain species in an otherwise similar mix as well as the presence of significant species e.g. *Apogon fasciata* in more than one group.

All the analyses tended to reinforce the importance of certain taxa, most notably flatfishes, grinders and nemipterids, but at each level groups were not always consistent (with the exception of the suite of sites from Princess Charlotte Bay). Nevertheless, the analysis of the fish data at the species level provided the most convincing evidence of site separation, albeit slight.

TRAWL SERIES V

This series was undertaken to enable more critical assessment of the community structure than was afforded by the binary data of series I and consisted of a tight grid of stations consistently sampled. Quantitative counts of species numbers were made. From the dendrogram (Fig. 5a) three site groups were accepted from the classification after transformation of the data (square root), thus:

I 1,5,6,8,10 and 11

II 2 and 7

III 3,4,9,12,13 and 14

The results of ordination (Fig. 5b) support these three groups.

The Cramer measure provided evidence of which species contributed to the groupings; this together with the dissimilarity measure indicated that group I was characterised by the fish *Upeneus sulphureus* and *Pomadasys argyreus* and to a lesser extent *Priacanthus tayenus* and *Apogon fasciata* as well as the crab *Portunus gracilimanus*. Overall, however, this region shares most of its fauna with the group III sites differing mainly in being considerably less diverse. The group II sites lacked much of the fauna of the other sites (especially site 7 which was quite depauperate), but contained several sponges and echinoderms not found elsewhere. By contrast the group III sites were rich in fauna: again fish appeared the dominant influence and the more important taxa were *Trachinocephalus myops*, *Synodus variegatus*, *Saurida undosquamis*,

Engyprosopon grandisquama and *Pristotis* (Daya) *jerdoni*. A few other invertebrate taxa contributed to the group separation, viz. *Comatula* spp. (Echinodermata), *Portunus* spp. (Crustacea) and some sponges.

Examination of influences upon ordination showed that fish again were dominant notably *Saurida tumbil*, *Nemipterus* sp. *Upeneus sulphureus*, *Priacanthus tayenus*, *Apogon fasciata* and *Pomadasys argyreus* which as well as the crab *Portunus gracilis* strongly influenced the pattern positively (i.e. contributed to group I sites). In contrast the fish *Synodus variegatus*, *Trachinocephalus myops*, *Saurida undosquamis*, the crabs *Portunus tenuipes* and *P. argentatus* together with the cephalopod *Sepia pharaonis* showed a strong negative influence (i.e. contributed to the group III sites).

All three site groups were considered in relation to depth, distance from shore and carbonate

concentration of their sediments. These parameters are clearly correlated with one another. Table 1 shows data for depth and distance from shore and Fig. 4c shows the distribution of carbonates.

TABLE 1. The depth, distance from shore in nautical miles, and zone of site groups from series V.

Site group	Depth (m)	Distance (n. miles)	Zone
I	21.9 9-55.8	6 2-19	Inshore
II	28.8 27-30.6	12.5 11-14	Transitional
III	42.8 30.6-57.6	23 12.5-32	Offshore

It can be seen that mean depth is reflected in distance from shore and that carbonate concentrations largely parallel these parameters (Fig. 4c). Sites 1, 5 and 10 are shallow inshore sites high in terrigenous sediments, sites 6 and 11 are

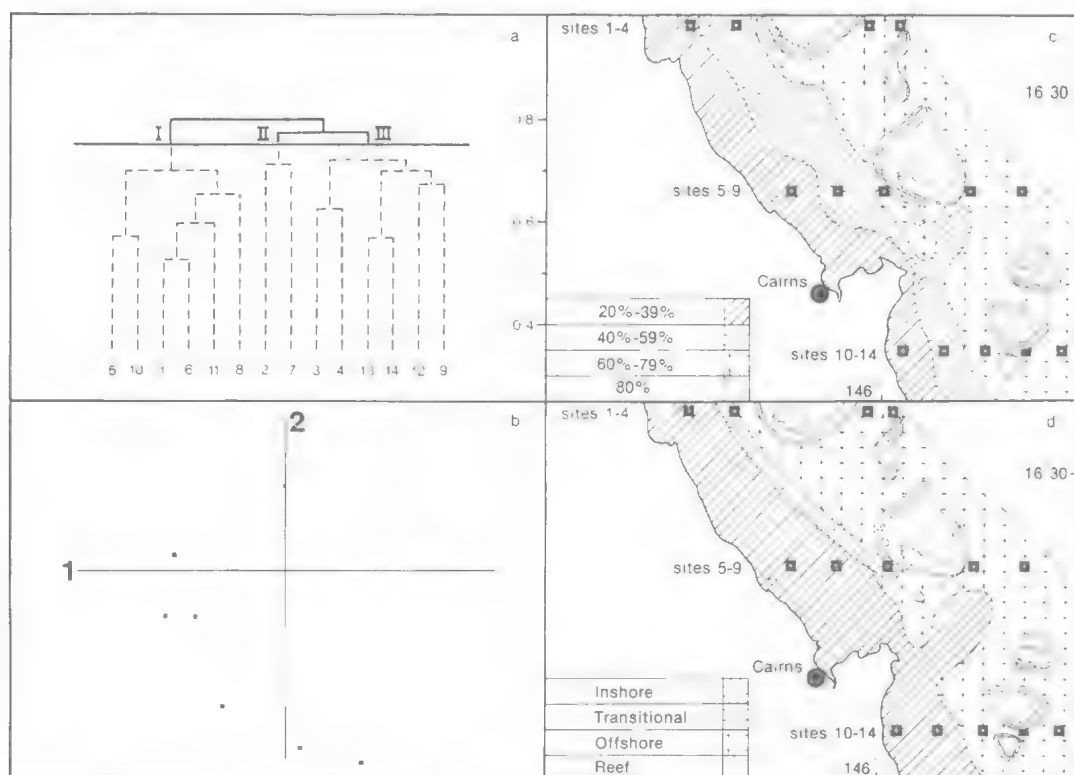


FIG 5. Analysis of sites from series V.

a. Classification

b. Ordination

I = ○, II = △, III = ■.

c. Distribution of sites in relation to carbonate content of sediments (after Maxwell, 1968).

d. Interpreted 'zonation' of reef in Cairns area.

slightly farther out with intermediate carbonate levels. Sites 2 and 7 also lie in the intermediate carbonate region. Sites 3,4,9,12,13 and 14 all clearly lie in the high carbonate region and are also farther out and deeper. Site 8 is somewhat anomalous: it is on the outer edge of Arlington Reef, is one of the deepest sites and lies in a high carbonate zone. Nevertheless, examination of Fig. 4c shows it lies just at the edge of an inshore extrusion through the Grafton Passage. In the analysis sites 9 and 12 showed a close affinity; these lie on the approximate southern edge of the Grafton Passage.

We conclude from these data that a broad inshore/offshore pattern occurs in the Cairns region. It is one related to depth and distance from shore, but appears influenced by sediment type and presumably currents. A 'zonation' is presented in Fig. 4d where a broad inshore component extends as a tongue through the Grafton Passage reflecting sediment type rather than depth or distance from shore. The reality of the transitional zone is questionable. Perhaps there are odd pockets of peculiar habitat or perhaps further sampling would blur these distinctions. Finally, earlier analysis of the untransformed data revealed a simpler chaining of sites from inshore to offshore with little discrimination, i.e. a relatively homogenous pattern with diversity attenuating towards the shore.

DISCUSSION

Central to the process of establishing the presence of biological zonation within the Great Barrier Reef Region is the debate over the structure of communities. There have been two schools of thought surrounding communities: one considers them structured, rigid groupings with well defined boundaries maintained by competition, the other as a variety of species spread along environmental continua — their individual abundances determined by environmental suitability. In work on marine benthos the debate arose when the classification of benthic fauna in shallow, tropical waters failed to completely support the definitive work of Peterson (1914, 1915, 1924) and Thorson (1957). Stephenson (1973) presented a thorough appraisal of methods and arguments concerning marine benthic community analysis and, furthermore, re-analysis of Petersen's original data by Stephenson, Williams and Cook (1972) only supported some of Petersen's original interpretations. As a consequence the more traditional concept of a structured community must be weakened. A similar debate has been

pursued in the botanical literature with the strong phytosociology school of the Europeans countered by the advocacy of the Americans for the continuum concept (see McIntosh, 1967 for a review).

In all the analyses of series I we see evidence of a great deal of homogeneity. Furthermore, there is little consistency between analyses regarding specific site groupings. The exception is the Princess Charlotte Bay sites which, because most of the trawls were conducted with different gear, may be justifiably excluded from further consideration. Nevertheless, analyses involving just the fish, but conducted at the species level, did indicate a broad inshore/offshore (shallow/deep) pattern.

Our results from the smaller scale series V sampling, which was carried out in a systematic and quantitative manner, do suggest the continental shelf in the Cairns area has two broad zones (inshore/offshore) related to sediment type and the correlated factors of depth and distance from shore. The taxa that best differentiated these zones were the 'errant' taxa of which fish are dominant. Indeed, in the various analyses certain taxa consistently appeared to strongly influence the results. Rainer and Munro (1982) used only fish and cephalopods in their study of the Gulf of Carpentaria in which they concluded similarly that a broad depth related (inshore/offshore) pattern existed.

It could be argued that the fish alone are sufficient to determine patterns. Trawling, however, is designed to collect demersal fauna, notably fish and prawns, and not to collect the epibenthic fauna. That it does catch this fauna is undeniable, but it is not designed to sample them accurately. Our conclusions that these components of the fauna are not as definitive as the fish in determining patterns reflects method rather than necessarily biological reality. No doubt rigorous sampling of the bottom with dredge and grab would reveal increased resolution of assemblages within the benthos. It could be argued that if clearly definable discontinuities existed in epibenthic fauna a reflection would be expected to occur in the associated demersal fauna. Emus are found on plains, cassowaries in forests. Our analysis based upon fauna sampled effectively with a trawl net (i.e. fish) suggests such clear discontinuities do not exist, at least in the inter-reef regions of the northern part of the Great Barrier Reef.

We believe the analyses have some important practical implications: they are that since fish (and

selected other species e.g. prawns) are effectively sampled they are likely the only ones worth sampling. Also fish are relatively easily sampled by trawling and are certainly more reliably identified than most invertebrates. Depending upon the geographical scale of the survey, the fishes alone may provide sufficient evidence of bottom type and faunal assemblages. Certainly McKay (1970) found that in Exmouth Gulf, Western Australia, catches of banana prawns were generally associated with the presence of the fish *Polydactylus specularis*.

Ordinations of the large Series I data set revealed vast areas of 'likeness' in terms of taxonomic composition. It was not possible to define a unique community type comprised of taxa which were generally absent or rare outside its boundaries. Instead, classifications were based on often subtle differences between large and diverse taxonomic suites which were geographically widely distributed (see Appendix 2), i.e. collections were indicative of a continuum although some confidence might be placed upon the fish.

Rainer (1984), after further examination of the data of Rainer and Munro (1982), concluded that although a basic depth related pattern existed it did show some seasonal shift (to deeper regions in September compared to March). He suggested the entire fish (and cephalopod) population was in a continual flux. Poiner and Harris (1985) reported on further trawling in the Gulf of Carpentaria in 1983. Their analyses of similar assemblages of fish and cephalopods revealed 'The site groups for each month make a coherent (inshore, offshore) topographical picture and conform reasonably well with the patterns detected by Rainer (1984) for the 1963/4 data set' MS p. 11. Thus there appears a basic agreement between both recent and past patterns within the Gulf of Carpentaria. Furthermore, our east coast data appear to conform to this same pattern. It may be that an inshore/offshore pattern is stable despite slight seasonal changes or others created by the advent of commercial trawling. The absence of clearly delineated assemblages, i.e. the presence of a continuum, we believe reflects a true biological phenomenon.

Differentiation of the Gulf of Carpentaria data was only achieved at a relatively high level of dissimilarity and this may have been aided by the ability to trawl over larger areas less restricted by 'foul ground'. Should it become possible to carry out broader based sampling over much of the Great Barrier Reef Region including 'foul' ground, then we would expect to find an extension

of our depth related zonation pattern north and south from the Cairns area.

In conclusion, if the assumption is correct that demersal fauna, predominantly fish, should reflect any major patterning of bottom communities, then, where conditions allow trawling, a fairly homogeneous assemblage occurs throughout large areas of the Great Barrier Reef. This continuum is broadly separable into a relatively rich offshore fauna and an inner, shallower component which is relatively depauperate, but has some characteristic species. Such a pattern may characterise much of the shallow tropical shelf of northern Australia.

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APPENDIX I

SUMMARY OF STATION DATA FOR TRAWL
SERIES O — VI
(NA = Not available)

TRAWL SERIES O (19 Feb to 21 Feb 1979)

Stn	Lat. (S)	Long. (E)	Depth (m)	Bottom Type
A	16°36.2'	145°44.5'	32.4	Mud
B	16°37.5'	145°44.8'	27.0	Mud
C	16°47.4'	145°52.2'	27.0	Mud
D	16°44.6'	145°53.9'	36.0	Mud
E	16°43.7'	145°49.0'	43.2	Sand, mud
F	16°45.0'	146°02.1'	54.0	Sand, mud
G	16°51.9'	146°07.1'	43.2	Mud
H	16°47.4'	146°07.5'	48.6	Shell
I	16°44.5'	146°12.2'	63.0	Sand, mud
J	16°39.9'	146°10.8'	92.0	Sand, sponge, coral
K	16°34.6'	146°12.4'	81.0	Sand, shell, <i>Halimeda</i>

TRAWL SERIES I (9 Oct to 4 Nov 1979)

Stn	Lat. (S)	Long. (E)	Depth (m)	Bottom Type
1	18°35.0'	145°49.5'	45.0	NA
2	18°19.0'	147°04.0'	75.6	NA
3	18°17.0'	146°31.0'	30.6	Coral rubble
4	17°43.8'	146°26.7'	41.4	NA
5	17°38.4'	146°34.0'	57.6	NA
6	17°38.0'	146°33.0'	59.4	Shell, weed
7	17°37.0'	146°34.0'	63.0	NA
8	17°36.8'	146°36.8'	64.8	NA
9	17°34.0'	146°27.5'	59.4	Shell, coral rubble
10	17°33.0'	146°26.0'	46.8	Coral rubble
11	17°31.0'	146°19.5'	41.4	NA
12	17°14.0'	146°27.0'	39.6	NA
13	17°13.5'	146°22.5'	48.6	Coral rubble
14	17°13.5'	146°17.0'	37.8	Coral rubble
15	17°11.0'	146°29.0'	66.6	Coral rubble
16	17°09.8'	146°23.5'	50.4	NA
17	17°08.0'	146°15.0'	41.4	Clean sand
18	17°08.7'	146°15.2'	43.2	NA
19	17°05.5'	146°16.0'	52.2	NA
20	17°05.0'	146°23.0'	50.4	NA
21	17°02.0'	146°25.2'	64.8	Coral rubble
22	17°01.5'	146°19.0'	48.6	NA
23	17°01.0'	146°20.0'	48.6	NA
24	17°00.5'	146°01.5'	22.5	Sandy, clean

25	16°59.5'	146°06.2'	37.8	Hard bottom	94	13°58.9'	144°14.9'	37.8	Mud, shell
26	16°57.3'	146°18.7'	57.6	Mud	95	13°55.4'	143°48.6'	21.6	Clean, hard
27	16°53.5'	146°18.0'	68.4	Coral rubble	96	13°52.2'	143°51.6'	30.6	Mud
28	16°53.2'	146°08.6'	43.2	Hard bottom	97	13°45.1'	143°48.2'	18.0	Mud, shell
29	16°50.0'	146°11.5'	46.8	NA	98	13°44.3'	143°48.0'	18.0	Shell
30	16°48.2'	146°07.5'	49.5	Clean bottom	99	13°38.6'	143°42.6'	25.2	Mud, shell
31	16°46.6'	146°07.0'	55.8	Coral rubble, mud	100	13°37.0'	143°44.9'	19.8	Clean
32	16°46.0'	146°03.8'	39.6	Clean sand	101	12°45.6'	143°32.2'	19.8	Mud
33	16°44.4'	146°12.0'	54.0	Mud	102	12°42.5'	143°28.8'	14.4	Clean
34	16°41.9'	146°11.2'	64.8	Clean	103	12°40.2'	143°28.8'	21.6	Soft, shell
35	16°34.6'	145°52.6'	37.8	Coral rubble	104	12°35.0'	143°25.7'	21.6	Clean, hard
36	16°34.5'	145°46.6'	30.5	Clean	105	12°34.5'	143°24.6'	16.2	Clean
37	16°33.3'	145°39.4'	22.5	Clean, hard	106	12°34.1'	143°23.4'	14.4	Mud
38	16°30.2'	145°56.4'	45.0	Clean sand	107	12°34.0'	143°24.7'	18.9	Mud, shell
39	16°30.4'	145°52.4'	42.3	Clean sand	108	12°33.1'	143°22.5'	14.4	Hard, clean, shell
40	16°25.2'	145°31.8'	17.1	NA	109	12°31.3'	143°25.8'	28.8	Mud, shell
41	16°15.2'	145°37.6'	39.6	NA	110	12°29.7'	143°20.3'	18.0	Hard, shell
42	16°08.0'	145°37.0'	43.2	NA	111	12°26.5'	143°22.6'	24.3	Clean, hard
43	16°04.2'	145°37.5'	30.6	NA	112	12°26.2'	143°22.4'	24.3	Hard, sand
44	15°59.3'	145°32.4'	28.8	NA	113	12°26.3'	143°19.7'	18.0	Sand
45	15°46.6'	145°42.1'	48.6	NA	114	12°20.1'	143°16.6'	15.3	Mud, shell
46	15°46.3'	145°35.8'	27.0	NA	115	12°16.8'	143°10.2'	12.6	Clean, hard
47	15°46.2'	145°34.2'	27.0	NA	116	12°11.6'	143°10.1'	18.0	Mud
48	15°45.4'	145°40.2'	43.2	Clay, mud	117	12°06.4'	143°10.1'	15.3	Shell
49	15°44.9'	145°40.9'	46.8	Clay, mud	118	12°06.4'	143°17.6'	37.8	Hard
50	15°44.8'	145°34.2'	39.6	NA	119	12°05.6'	143°13.3'	29.7	Hard
51	15°42.7'	145°28.5'	27.0	Coral rubble	120	12°01.8'	143°13.3'	15.3	Mud
52	15°36.2'	145°26.8'	21.6	NA	121	11°53.8'	143°12.2'	30.6	Hard, weed
53	15°23.3'	145°29.0'	28.8	Clean, hard	122	11°47.2'	143°11.4'	34.2	Mud
54	15°13.3'	145°27.1'	30.6	Clean	123	11°45.2'	143°03.0'	19.8	Clean, hard
55	15°06.0'	145°29.4'	34.2	Clean, hard	124	11°41.8'	143°08.3'	32.4	Hard, smooth
56	14°48.0'	145°25.0'	28.8	NA	TRAWL SERIES II (20 June to 28 June 1980)				
57	14°42.0'	145°04.5'	9.0	NA	Sta	Lat. (S)	Long. (E)	Depth (m)	Bottom Type
58	14°40.0'	145°07.5'	10.8	NA	1	22°15.5'	152°43.5'	36.0	Flat, clean
59	14°39.0'	145°20.0'	19.8	Mud, shell	2	22°15.7'	152°41.1'	61.2	Rubble
60	14°38.5'	145°13.0'	13.5	NA	3	22°16.8'	152°40.5'	50.4	Flat, clean
61	14°36.0'	145°03.0'	12.6	NA	4	22°08.4'	152°35.5'	50.4	NA
62	14°35.3'	145°23.0'	27.0	Mud, shell	5	22°02.1'	152°27.7'	57.6	NA
63	14°32.2'	145°07.5'	19.8	NA	6	21°53.2'	152°19.7'	57.6	NA
64	14°27.8'	144°51.0'	12.6	Clean, hard	7	21°40.2'	152°14.7'	54.0	NA
65	14°26.5'	144°44.0'	12.6	Mud, weed	8	21°40.0'	152°10.3'	61.2	NA
66	14°23.9'	144°42.1'	18.0	Mud	9	21°38.3'	152°04.5'	57.6	Sand, weed
67	14°20.2'	144°51.0'	23.4	Rubble	10	21°40.2'	152°04.2'	63.0	NA
68	14°12.0'	144°03.0'	18.9	NA	11	21°44.0'	152°04.0'	54.0	NA
69	14°12.0'	144°04.3'	18.9	NA	12	21°46.9'	152°50.0'	54.0	NA
70	14°12.0'	144°05.8'	21.6	NA	13	21°45.2'	152°01.2'	48.6	NA
71	14°11.5'	144°06.9'	21.6	NA	14	21°50.1'	152°02.5'	59.4	NA
72	14°11.4'	144°02.0'	19.8	Clean	15	21°50.2'	152°09.6'	43.0	NA
73	14°11.0'	144°25.4'	6.3	Mud	16	21°52.4'	152°12.6'	52.0	NA
74	14°10.8'	144°02.0'	18.9	Shell	17	21°58.6'	152°16.2'	50.4	NA
75	14°10.8'	144°05.9'	21.6	Clean	TRAWL SERIES III (13 Sept to 4 Oct 1980)				
76	14°10.8'	144°04.2'	23.4	Clean	Sta	Lat. (S)	Long. (E)	Depth (m)	Bottom Type
77	14°10.7'	144°02.3'	21.6	Clean, shell	1	26°31'	153°48'	480	—
78	14°10.6'	144°08.6'	21.6	Clean	2	26°20'	153°53'	300	—
79	14°10.4'	144°01.3'	21.6	Clean, shell	3	25°27'	153°46'	330	—
80	14°10.4'	144°09.4'	21.6	Clean	4	25°11'	153°45'	330	—
81	14°10.4'	144°08.4'	21.6	Clean	5	23°59'	152°47'	320	—
82	14°10.0'	144°01.2'	21.6	Clean	6	23°28'	153°19'	562	—
83	14°10.0'	144°01.2'	22.5	Mud, shell	7	23°30'	153°04'	540	—
84	14°09.6'	144°02.0'	21.6	NA	8	23°11'	153°00'	420	—
85	14°09.6'	144°05.3'	21.6	Rubble	9	22°10'	154°10'	570	—
86	14°09.3'	144°03.3'	22.5	Rubble	10	22°09'	153°55'	400	—
87	14°08.8'	144°24.5'	18.9	Hard, clean					
88	14°07.1'	144°26.4'	22.5	Clean					
89	14°05.3'	144°04.7'	25.2	Coral					
90	14°04.1'	144°26.1'	30.6	Mud					
91	14°01.0'	143°56.6'	27.0	Mud					
92	14°01.0'	144°10.4'	34.2	NA					
93	14°00.9'	143°54.5'	25.2	Shell					

11	21°30'	152°56'	240	—
12	21°41'	152°51'	150	—
13	24°05'	152°53'	315	—
14	23°58'	152°45'	212	—
15	23°50.6'	152°36.2'	270	—
16	23°42.5'	152°24.8'	216	—
17	23°36.6'	152°22.9'	205	—
18	23°26'	152°16'	205	—
19	23°36.3'	152°43.2'	360	—
20	23°10.6'	152°12.3'	135	—
21	22°56.1'	152°32.2'	144	—
22	22°51.7'	152°45.7'	261	—
23	22°54.5'	152°12.5'	351	—
24	23°00.3'	153°18.8'	387	—
25	22°36.7'	154°14.0'	522	—
26	23°15.3'	154°21.7'	549	—

TRAWL SERIES IV (8 Oct to 10 Oct 1980)

Stn	Lat. (S)	Long. (E)	Depth (m)	Bottom Type
1	16°48.8'	145°58.4'	41.0	—
2	16°46.3'	145°57.9'	40.0	—
3	16°44.5'	145°56.5'	30.0	—
4	16°42.8'	145°56.3'	39.0	—
5	16°44.3'	145°59.4'	45.0	—
6	16°44.0'	145°59.6'	47.0	—
7	16°43.9'	146°00.7'	51.0	—
8	16°44.8'	146°02.1'	50.0	—
9	16°45.6'	146°01.5'	40.0	—
10	16°47.0'	145°58.9'	45.0	—
11	16°48.5'	145°59.6'	50.0	—
12	16°48.9'	146°00.4'	50.0	—
13	16°48.8'	146°01.2'	36.5	—
14	16°48.5'	146°02.5'	36.5	—
15	16°48.1'	146°03.7'	40.0	—
16	16°46.8'	146°04.9'	41.0	—

TRAWL SERIES V (21 Jan to 28 Jan 1981)

Stn	Lat. (S)	Long. (E)	Depth (m)	Bottom Type
1	16°23.0'	145°30.8'	14.4	Clean, hard, sandy
2	16°23.0'	145°37.0'	27.0	Clean
3	16°23.0'	145°55.6'	50.4	NA
4	16°23.0'	146°01.6'	57.6	Silt, shell debris
5	16°43.0'	145°43.0'	10.8	Some weed
6	16°43.0'	145°49.2'	19.8	Clean
7	16°43.0'	145°55.4'	30.6	Some weed
8	16°43.0'	146°07.8'	55.8	Clean
9	16°43.0'	146°13.8'	42.5	Weed
10	17°03.0'	145°55.6'	9.0	Clean
11	17°03.0'	146°01.7'	21.6	Clean
12	17°03.0'	146°07.8'	30.6	NA
13	17°03.0'	146°14.0'	36.0	Clean
14	17°03.0'	146°20.0'	39.6	Clean

TRAWL SERIES VI (25 April to 5 May 1982)

Stn	Lat. (S)	Long. (E)	Depth (m)	Bottom Type
1	17°00'	145°55.0'	10.0	—
2	17°00'	145°57.0'	20.0	—
3	17°00'	146°00.0'	25.0	—
4	17°00'	146°03.0'	30.0	—
5	17°00'	146°05.8'	35.0	—
6	17°00'	146°21.1'	55.0	—
7	17°00'	146°24.5'	55.0	—

8	17°00'	145°58.0'	22.0	—
9	17°00'	146°01.0'	23.0	—
10	17°00'	146°04.5'	34.0	—
11	17°00'	146°07.0'	35.0	—
12	17°00'	146°08.0'	42.0	—
13	17°00'	146°08.5'	30.0	—
14	17°00'	146°17.5'	58.0	—
15	17°00'	146°18.4'	55.0	—
16	No sample			—
17	16°59.0'	146°19.0'	53.0	—
18	17°00'	146°26.0'	52.0	—
19	17°00'	146°27.0'	35.0	—
20	16°45.0'	146°18.5'	50.5	—
21	16°45.0'	146°12.5'	31.0	—

APPENDIX II

CHECKLIST OF FAUNA
FROM TRAWL SERIES O — VI

PORIFERA

Adocidae	
<i>Adocia</i> sp.	III(15, 18)
<i>Sigmatocia</i> sp.	III(26)
Anchinoidae	
<i>Anchinoidae</i> sp.	I(52)
Aplysillidae	
<i>Aplysilla</i> sp.	V(2, 9)
<i>Darwinella</i> sp.	I(41)
<i>Darwinellopsis</i> sp.	I(14)
<i>Aplysillidae</i> sp.	II(3) V(12)
Aplysinellidae	
<i>Aplysina</i> sp.	I(5)
<i>Psammoplysilla</i> sp.	V(2)
<i>Pseudocerotina</i> sp.	II(2, 5)
<i>Aplysinellidae</i> sp.	I(50)
Axinellidae	
<i>Acanthella</i> sp.	I(51, 60, 61, 115) IV(7) V(9)
<i>Axiomon folium</i>	I(63) VI(7)
<i>Axinella</i> sp.	IV(1)
<i>Axinectya mariana</i>	V(5)
<i>Raphoxya pallida</i>	I(—)
<i>Axinellidae</i> spp.	O(I) I(35, 63) IV(1) V(9)
Biemnidae	
<i>?Biemna</i> sp.	I(52)
Callyspongiidae	
<i>Callyspongia</i> ? <i>confederata</i>	I(4, 42, 44) V(12)
<i>C. subarmigera</i>	I(97, 115, 117)
<i>C. ?subarmigera</i>	V(2)
<i>Callyspongia</i> spp.	I(2, 4, 5, 14, 26, 58) II(4, 5, 11) III(2, 4, 5, 14)
<i>?Euplaccella</i> sp.	I(115)
<i>Siphonochalina</i> spp.	I(4, 114) II(5) V(2, 4, 9)
<i>?Siphonochalina</i> spp.	V(2, 4, 9)
<i>Toxochalina</i> sp.	I(4, 14)
<i>Callyspongiidae</i> sp.	O(E) I(27, 97, 115, 116)
	IV(5) VI(7)
Chondrosiidae	
<i>Chondrilla australiensis</i>	V(2)
<i>Chondrilla</i> sp.	II(2)
<i>Chondrosiidae</i> sp.	I(13, 80, 102) II(1, 8) V(7)
Clionidae	
<i>Clionidae</i> sp.	I(63) V(2) VI(7)
Coelosphaeridae	
<i>Histoderma</i> sp.	III(18)
Desmacellidae	
<i>Kerasemna horrida</i>	I(44)

Desmacionidae		Mycalidae	
<i>Desmapsamma</i> sp.	V(9)	<i>Mycale tylstrongyla</i>	I(52)
<i>Forcepia</i> sp.	V(2)	Mycalidae sp.	II(5)
<i>Liosina</i> sp.	I(56)	Myxillidae	
Desmoxiidae		<i>Ectomyxilla</i> sp.	I(41)
<i>Higginsia</i> sp.	I(63)	<i>Lissodendoryx</i> spp.	I(20) II(8, 13)
Dictyodendrillidae		Myxillidae sp.	I(41)
? <i>Dictyodendrilla</i> spp.	V(3)	Nepheliospongidae	
Dictyodendrillidae spp.	O(I, K) I(4, 21, 27, 51, 56)	Nepheliospondidae sp.	III(10)
	II(3) VI(11, 14)	Niphatidae	
Dysideidae		<i>Amphimedon</i> spp.	I(2, 4, 44, 53, 63) III(5, 6, 13)
<i>Dysidea</i> spp.	I(44, 51, 56, 58, 100) V(3, 7)	<i>Cribrochalina</i> spp.	I(43) II(-)
<i>Spongionella</i> spp.	V(2, 9)	<i>Gelliodes fibulata</i>	I(97)
Dysideidae spp.	O(K) V(3)	<i>Niphates</i> spp.	I(38) II(5, 14, 17) V(9)
Geodiidae		O(C, D) I(51, 97) IV(1)	
<i>Geodia</i> cf. <i>regina</i>	III(8, 13)	Niphatidae sp.	VI(7, 13)
<i>Geodia</i> spp.	III(8, 19) V(9, 12)	Oceanapiidae	
Halichondridae		<i>Biminia</i> sp.	I(122)
? <i>Ciocalyptra</i> sp.	III(19)	<i>Calyx</i> sp.	I(51)
<i>Halichondria</i> spp.	O(E, F, J) I(43, 52, 66)	<i>Pachypellina</i> sp.	II(6)
	IV(4, 9,) V(12)	Oceanapiidae sp.	V(12)
<i>Rhaphisia</i> sp.	V(2, 12)	Petrosiidae	
? <i>Trachyopsis</i> sp.	V(9)	<i>Xestospongia</i> sp.	I(113)
Halichondridae spp.	I(41, 51, 52, 113)	Phorbasidae	
Haliclonidae		<i>Echinodictyum carolinoides</i>	I(61)
<i>Haliclona</i> spp.	I(4, 5, 56, 60) III(4) V(6, 9)	? <i>Myrmekioderma</i> sp.	I(11, 60, 63)
? <i>Reniera</i> sp.	I(69)	Pollacidae	
? <i>Sigmadocia</i> sp.	I(4, 5, 37, 51, 52, 53)	<i>Semperella</i> cf. <i>schultzei</i>	III(7, 10, 11, 26)
Haliclonidae spp.	O(D) I(27, 63) VI(7)	Pollacidae sp.	III(19)
Halisarcidae		Psammascidae	
Halisarcidae sp.	VI(14)	? <i>Holopsamma</i> sp.	I(4, 41)
Hemistrellidae		<i>Psammascus chaliniformis</i>	I(10, 26, 35)
<i>Vibulinus</i> sp.	I(51)	? <i>Psammopemma</i> spp.	I(26) V(9, 12)
Heterocoelidae		Psammascidae sp.	II(8, 10, 11)
? <i>Aphrocerus</i> sp.	I(103)	Raspailiidae	
<i>Leucettusa</i> sp.	I(35) IV(2, 26, 7)	<i>Raspailia</i> sp.	IV(12)
? <i>Leucettusa</i> sp.	IV(4)	Sigmaxinellidae	
Heterocoelidae spp.	IV(2)	Sigmaxinellidae sp.	I(51)
Homocoelidae		Spirastrellidae	
<i>Leucosolenia</i> sp.	V(9)	<i>Spirastrella</i> ? <i>montiformis</i>	I(61)
Hyalonematidae		<i>Spirastrella</i> sp.	IV(4) V(2)
<i>Hyalonema</i> sp.	III(25)	Spirastrellidae spp.	I(52, 64)
<i>Pheronema</i> spp.	III(10, 19)	Spongiidae	
Hyalonematidae sp.	III(19)	<i>Cacospongia</i> spp.	I(41, 43) V(2, 9)
Hymeniacionidae		? <i>Carteriospongia</i> sp.	V(2)
<i>Hymeniacion</i> sp.	III(19)	<i>Coscinoderma</i> spp.	II(1, 6, 7, 13, 14, 15) IV(6)
Hymeniacionidae spp.	I(11, 49, 59) V(9, 12)		V(9, 12)
Ianthellidae		<i>Dactylospongia</i> sp.	V(2, 12)
? <i>Bajalus</i> sp.	II(11)	<i>Hippospongia aphroditella</i>	I(61)
<i>Ianthella basta</i>	II(15)	<i>Hippospongia</i> sp.	V(2) VI(18)
<i>Ianthella</i> sp.	III(-)	? <i>Hippospongia</i> sp.	I(52)
Ianthellidae spp.	III(14)	? <i>Hyattella</i> spp.	I(58, 79) V(12)
Jaspidae		? <i>Leiosella</i> sp.	I(11)
<i>Jaspis</i> sp.	I(25, 35) V(2)	<i>Spongia</i> spp.	I(26, 46) II(5) III(10, 19)
Leucettidae			V(9)
Leucettidae spp.	II(2, 7, 8, 10, 11, 14)	Spongiidae spp.	O(D, I) I(21, 43) III(4, 10)
Microcionidae			IV(-) V(9) VI(7)
<i>Acarnus erithacus</i>	I(9)	Stellidae	
<i>A. topsenti</i>	I(57)	<i>Myriastrea</i> sp.	I(97)
<i>Clathria hartmeyeri</i>	I(14)	<i>Stelletta</i> cf. <i>maxima</i>	III(19)
<i>C. rotunda</i>	III(4)	<i>Stelletta</i> spp.	III(8, 13, 15, 18, 19, 25)
<i>Clathria</i> spp.	I(14, 52, 55, 119) IV(6) V(2)	Stellettidae spp.	O(E, J) I(42)
<i>Echinochalina anomala</i>	V(4)	Suberitidae	
<i>Echinochalina intermedian</i>	I(14)	<i>Aaptos</i> sp.	IV(12)
? <i>Echinochalina</i> spp.	I(29, 72)	? <i>Laxosuberites</i> sp.	I(-)
<i>Echinoclathria</i> sp.	I(72) III(1)	? <i>Terpios</i> sp.	I(115)
<i>Isociona tuberosa</i>	I(4, 14, 55)	Tedaniidae	
Microcionidae spp.	V(12)	<i>Isotrochota baculifera</i>	I(61, 89)

<i>I. coccinea</i>	I(35)
<i>Tedania</i> sp.	V(4)
Tethyidae	
<i>Tethya</i> sp.	II(17)
Tethyidae sp.	I(7)
Tetillidae	
<i>Cinachya</i> sp.	V(9)
? <i>Cinachya</i> sp.	III(19)
<i>Craniella simillima</i>	I(—)
<i>Craniella</i> sp.	III(8, 19) IV(9, 12) V(9)
<i>Raphidotethya enigmata</i>	V(9)
<i>Raphidotethya</i> spp.	I(9, 14) IV(2)
Tetillidae spp.	O(K) IV(4, 8)
Thorectidae	
? <i>Fascaplysinopsis</i> sp.	II(13)
? <i>Fasciospongia</i> sp.	I(14)
<i>Hyrtios</i> sp.	I(35, 51, 52, 62, 115) II(10, 11)
<i>Ircinia</i> sp.	I(4, 14, 35, 60, 62, 72, 76, 89, 92) III(11) V(8)
<i>Psammocinia</i> spp.	II(2, 10, 11, 13, 14)
<i>Sarcotragus</i> spp.	I(9) II(13) V(4)
? <i>Sarcotragus</i> sp.	III(14)
<i>Smenospongia</i> sp.	I(35)
<i>Thorecta</i> sp.	I(55) V(2)
Thorectidae spp.	O(D, E) I(27, 51, 52, 60, 86)
	II(2, 11, 12) V(4) VI(6, 7)

CNIDARIA

Acanthogorgiidae	
<i>Acalycigorgia</i> sp.	I(97)
<i>Acanthogorgia</i> sp.	III(26)
<i>Muricella</i> sp.	III(22)
? <i>Acanthogorgiidae</i> sp.	I(122)
Acroporidae	
<i>Acropora</i> spp.	I(43) IV(1, 2)
<i>Montipora</i> sp.	I(42)
Agariciidae	
<i>Leptoseria</i> sp.	I(43)
Alcyoniidae	
<i>Sarcophyton</i> sp.	I(43) V(9)
? <i>Sinularia</i> sp.	I(63, 103, 112)
<i>Sinularia</i> sp.	I(43)
Anthothelidae	
<i>Alertigorgia orientalis</i>	I(107, 111, 114, 116, 120)
? <i>Iciligorgia</i> sp.	O(J)
<i>Solenocaulon</i> sp.	O(B, I) I(38, 77) IV(1)
Antipathidae	
<i>Antipathes</i> spp.	I(2, 14, 38, 43)
<i>Cirripathes</i> spp.	O(J) I(3, 14, 70, 72, 74, 86, 89, 90, 97, 98, 101, 110, 112)
<i>Parantipathes</i> sp.	I(2, 31, 42)
Antipathidae sp.	I(121)
Briareidae	
Briareidae sp.	V(9)
Caryophyllidae	
<i>Euphyllia</i> sp.	I(58)
<i>Stephanotrochus</i> sp.	III(26)
Caryophyllidae sp.	III(8)
Chrysogorgiidae	
<i>Chrysogorgia</i> spp.	III(6, 8, 25)
Clavulariidae	
? <i>Clavularia</i> sp.	I(97)
Coralliidae	
Coralliidae sp.	III(22)
Dendrophylliidae	
<i>Balanophyllia</i> sp.	I(119)
<i>Dendrophyllia</i> cf. <i>miniscula</i>	III(21)

<i>Dendrophyllia</i> spp.	I(20, 29) III(—)
<i>Turbinaria</i> spp.	I(43, 64)
Ellisellidae	
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<i>Junceella</i> ? <i>gemmacea</i>	I(31)
<i>Nicella</i> sp.	I(42) II(8)
Epizoanthidae	
<i>Epizoanthus</i> sp.	III(25, 26)
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<i>Caulastrea furcata</i>	O(K)
<i>Favites</i> sp.	II(7)
<i>Plesiastrea</i> sp.	I(51, 103)
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<i>Flabellum</i> sp.	II(7) III(23, 25, 26)
? <i>Gardineria</i> sp.	I(4, 18, 41, 42, 51, 56, 58, 107, 115) IV(1, 12)
<i>Placotrochus</i> sp.	IV(1, 2, 6, 12)
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<i>Cycloseris</i> ? <i>cyclolites</i>	I(52, 57, 60, 64, 103)
<i>Cycloseris</i> sp.	I(51, 101)
<i>Diaseris</i> sp.	O(K)
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<i>Lophogorgia</i> sp.	O(J)
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<i>Keratoisis</i> sp.	III(10)
Lafoeidae	
<i>Acryptolaria</i> sp.	III(26)
? <i>Zygophlax</i> sp.	I(1)
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Melithaeidae sp.	V(2)
Milleporidae	
Milleporidae sp.	IV(1)
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<i>Dendronephthya</i> ? <i>brevirama</i>	I(7, 18, 42, 45, 52, 61, 89, 92, 112, 119)
<i>D. mollis</i>	II(12)
<i>D. ?mollis</i>	II(2, 8, 19, 22, 28, 43, 45, 52, 112)
<i>Dendronephthya</i> spp.	O(J) I(29) IV(4, 5, 7, 12, 16)
? <i>Dendronephthya</i> sp.	II(8)
<i>Nephthea</i> sp.	V(9)
<i>Umbellulifera</i> sp.	I(74)
Nephtheidae spp.	I(34, 43) IV(1) III(11)
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<i>Siphonogorgia</i> sp.	O(J)
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<i>Studeriotis</i> sp.	I(58)
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<i>Muricella</i> sp.	III(22)
Pennatulidae	
<i>Pennatula</i> sp.	III(10)
Pennatulidae sp.	III(1, 2, 6, 7, 8, 23, 26)
Plexauridae	
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<i>Eunicea</i> sp.	III(20)
<i>Euplexaura</i> ? <i>robusta</i>	I(97, 122)
<i>Pseudoplumarella echidna</i>	I(43)
Plexauridae sp.	II(2)
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? <i>Aglaophenia</i> sp.	II(6, 12) IV(12)
<i>Gymnangium</i> cf. <i>gracicaule</i>	II(7)
<i>G. longicornus</i>	I(111, 118) V(3)
<i>G. cf. longirostre</i>	II(8)
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<i>Thecocarpus</i> sp.	III(8)

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<i>Alveopora</i> sp.	I(51)				
Primnoeidae					
<i>Callogorgia</i> spp.	III(6)				
<i>Narella</i> sp.	III(10)				
<i>Plumarella</i> sp.	III(6,7)				
<i>Thouarella</i> cf. <i>hilgendorfi</i>	III(6)				
<i>Thouarella</i> sp.	III(10)				
<i>Primnoeidae</i> sp.	III(6, 22, 25)				
Pteroeididae					
<i>Pteroeides</i> spp.	I(90, 111, 112)				
Sertulariidae					
? <i>Salacia</i> sp.	II(2)				
<i>Sertularella diaphana</i>	II(2)				
<i>S.</i> ? <i>diaphana</i>	I(72, 101)				
? <i>Sertulariidae</i> sp.	I(112)				
F.Subergorgiidae					
<i>Subergorgia verriculata</i>	I(26, 114)				
<i>Subergorgia</i> sp.	V(9)				
<i>Subergorgiidae</i> sp.	IV(1)				
Synthechiidae					
<i>Synthecium</i> ? <i>patulum</i>	I(92)				
<i>Synthecium</i> spp.	O(F, I, K) I(41, 97, 101)				
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<i>Telesto</i> sp.	O(I)				
? <i>Telesto</i> sp.	I(31)				
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<i>Trachyphyllia geoffroyi</i>	I(58, 61, 63, 64, 101) II(7, 15, 16)				
Veretillidae					
<i>Lituaria australasiae</i>	O(B)				
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<i>Scytalium</i> spp.	I(44, 48, 116)				
Xeniidae					
<i>Xenia</i> spp.	V(9)				
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<i>Sphenopus marsupialis</i>	O(B, F, J) I(1, 2, 4, 6, 10, 11, 22, 32, 42, 45, 56, 58, 63, 112, 118, 119) V(12, 13)				
Undetermined					
<i>Actinaria</i> spp.	I(101) III(6, 7, 15, 17, 22, 25, 26)				
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? <i>Patro australis</i>	I(5, 49)				
? <i>Anomiidae</i> sp.	I(101)				
Aplysiidae					
<i>Aplysiidae</i> sp.	I(35)				
? <i>Aplysiidae</i> sp.	III(1)				
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<i>Arca subnavicularis</i>	I(93, 96, 97, 101, 102, 113, 118, 119) II(8)				
<i>Arca</i> sp.	IV(16)				
<i>Cucullaea labiata</i>	I(96)				
<i>Opularca tennella</i>	I(59, 92, 93, 97, 110, 119, 121) IV(8)				
<i>Trisidos semitorta</i>	I(93, 119)				
Argonautidae					
<i>Argonauta</i> sp.	III(25)				
Arminidae					
? <i>Armina</i> sp.	III(1)				
Bursidae					
<i>Bursa rana</i>	I(9, 13, 22, 48, 56, 79, 89, 97, 104) VI(6, 8, 12, 16)				
<i>Bursa</i> sp.	O(H)				
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<i>Fragum fragum</i>	IV(16)				
<i>Fragum</i> sp.	I(22)				
<i>Hemicardium</i> ? <i>subretusum</i>	I(124)				
<i>Nemocardium probatum</i>	I(4)				
<i>Plagiocardium setosum</i>	IV(6)				
Cassidae					
<i>Phalium bisulcatum</i>	I(14) IV(8)				
Chamidae					
<i>Chama pulchella</i>	I(52, 93, 97, 98, 101, 119)				
<i>C. reflexa</i>	I(103)				
<i>Chama</i> spp.	I(55, 117)				
Conidae					
<i>Conus cancellata</i>	I(14)				
<i>C. planorbis</i>	I(3)				
Corbulidae					
<i>Aloidis hydropica</i>	I(66, 90) V(5, 14)				
Cymatiidae					
<i>Cymatium pfeifferianus</i>	I(10, 41, 56, 64, 64, 102, 111, 115) IV(5, 6, 12, 16) VI(4, 6)				
<i>Distorsio reticulata</i>	I(9, 11, 22, 26, 48, 49, 96, 97, 112) IV(9, 12) V(1) VI(5, 6)				
<i>Gyrineum</i> sp.	IV(8)				
? <i>Linatella</i> sp.	I(115)				
<i>Ranularia caudata</i>	I(2, 11, 28)				
Cypraeidae					
<i>Cypraea labrolineata</i>	IV(8)				
<i>C. ?miliaris</i>	IV(12)				
<i>C. pyriformis</i>	IV(6)				
Dentaliidae					
<i>Dentalium</i> ? <i>javanum</i>	I(42, 94)				
Dorididae					
<i>Dorididae</i> sp.	V(9)				
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<i>Abralia</i> sp.	III(2, 14)				
<i>Enoplateuthis galaxius</i>	III(1, 6, 26)				
<i>Enoplateuthis</i> sp.	III(1)				
Fascioliariidae					
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Glycymeridae					
<i>Melaxinaea labyrinth</i>	I(49, 90, 101, 107) V(4)				
Haminoeidae					
<i>Alys naucum</i>	I(64)				
Isognomontidae					
<i>Isognomon isognomon</i>	I(97, 119)				
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<i>Circlimopa woodwardi</i>	I(94)				
Loliginidae					
<i>Loligo chinensis</i>	III(11, 15, 22) VI(1, 2, 3, 5, 6, 7)				
<i>Loligo</i> sp.	O(B, J) V(1, 2, 3, 5, 6, 11, 12)				
Malleidae					
<i>Malleus albus</i>	I(1, 2, 19, 85, 93, 94, 100, 101, 103, 104, 110, 113, 115, 119) II(14, 15, 17) IV(2) VI(4)				
<i>Vulsella vulsella</i>	I(121)				
Muricidae					
<i>Bedevea paiyae</i>	I(121)				
<i>Chicoreus axicornus</i>	I(61, 98) II(7)				

<i>C. cervicornis</i>	I(119)		
<i>Haustellum</i> sp.	II(7)		
<i>Murex nigrospinosus</i>	VI(11)		
<i>M. tribulus</i>	I(2, 4, 7, 8, 9, 13, 29, 42, 50)		
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<i>Musculus</i> sp.	I(5, 96)		
<i>Septifer bilocularis</i>	I(97)		
<i>Stavelia horrida</i>	I(97, 98)		
Nassariidae			
<i>Nassarius dorsatus</i>	IV(12)		
Naticidae			
<i>?Polinices melanostomus</i>	I(61)		
Octopodidae			
<i>Eledone</i> sp.	III(4, 14, 15)		
<i>Haplochaena lunulata</i>	I(62)		
<i>Octopus</i> spp.	I(86, 92, 97) II(10, 12) III(3, 7, 22, 23, 26,) V(5)		
Ommastrephidae			
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<i>Todaropsis eblanae</i>	III(5, 15)		
Ostreidae			
<i>Ostrea trapezina</i>	I(34, 44, 52, 55, 89, 93, 101, 113, 115, 121) V(12)		
<i>?Pycnodonte hyotis</i>	II(8)		
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<i>Volva volva</i>	I(11, 29, 64) VI(4)		
Pectinidae			
<i>Amusium balloti</i>	O(A, B, C, D) I(2, 4, 6, 7, 8, 9, 10, 11, 13, 18, 19, 22, 25, 29, 34) II(4, 16) IV(12) VI(7)		
<i>A. pleuronectes</i>	I(5, 9, 10, 17, 18, 19, 22, 23, 30, 32, 37, 39, 40, 41, 42, 44, 45, 46, 47, 49, 50, 51, 52, 67, 68, 70, 71, 72, 74, 76, 77, 79, 80, 82, 84, 85, 86, 92, 94, 95, 96, 97, 101, 102, 104, 105, 106, 107, 111, 112, 117, 119, 120, 122, 123, 124) V(1, 5, 6, 8, 11, 12, 14) VI(2, 3, 4, 5, 6, 7)		
<i>Annachlamys leopardus</i>	I(86, 101, 119)		
<i>Chlamys gloriosa</i>	V(3)		
<i>C. ?gloriosa</i>	I(92, 93, 97, 98, 111)		
<i>Chlamys</i> sp.	IV(12)		
<i>Decatopecten ?strangei</i>	I(113)		
<i>Pecten</i> spp.	I(64) II(7, 8, 12, 14, 17) III(6, 26)		
Philinidae			
<i>Philine</i> sp.	I(110)		
Pleurobranchidae			
<i>?Euselenops</i> sp.	V(9)		
<i>Pleurobranchidae</i> sp.	I(8)		
Pleurophyllidae			
<i>Pleurophyllidia</i> sp.	I(45)		
Plicatulidae			
<i>Plicatula essingtonensis</i>	I(55, 89, 100, 101, 117)		
Pteriidae			
<i>Pinctada panasesae</i>	I(115)		
<i>Pinctada</i> sp.	I(1, 93, 98)		
<i>Pteriidae</i> spp.	I(98) IV(1)		
Sepiariidae			
<i>Sepioloidea lineolata</i>	III(14) V(4)		
<i>?Sepioloidea lineolata</i>	I(7)		
Sepiidae			
<i>Sepia cultrata</i>	III(2, 5, 14, 19, 23)		
<i>S. elliptica</i>	I(11, 22, 25, 36, 44, 45, 46,		
	53, 66, 69, 72, 79, 83, 85, 87, 88, 90, 102, 106, 119)		
	V(5) VI(2, 3)		
<i>S. ?novaehollandiae</i>	II(8, 11, 13, 16)		
<i>S. papuensis</i>	V(9, 12)		
<i>S. ?papuensis</i>	I(58, 102) IV(1, 2)		
<i>S. pfefferi</i>	I(2, 5, 47, 103) II(13) IV(6, 12) V(13) VI(4)		
<i>S. pharaonis</i>	V(3, 12, 13, 14) VI(2, 3, 4)		
<i>S. ?pharaonis</i>	V(41, 47, 91, 102, 119) VI(1, 3)		
<i>S. plangon</i>	I(9, 47, 61) V(2, 9, 12)		
<i>S. rex</i>	III(3, 11, 14, 15, 18)		
<i>S. smithi</i>	I(7) V(12)		
<i>S. whitleyana</i>	(2, 7, 18, 19, 24, 30, 41, 53) V(13, 14) VI(3)		
<i>Sepia</i> spp.	O(B) I(46) III(1, 2, 5, 18)		
Sepiolidae			
<i>Euprymna</i> sp.	III(14)		
<i>?Euprymna</i> sp.	I(24)		
<i>Rossia</i> sp.	III(6, 7, 23, 25)		
Siliquariidae			
<i>Siliquaria</i> sp.	I(14, 26, 103) IV(6, 8)		
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<i>Spondylus ?barbatus</i>	I(115)		
<i>S. ?ducalis</i>	I(119)		
<i>S. tenellus</i>	IV(8)		
<i>S. cf. tenellus</i>	VI(4)		
<i>S. wrightianus</i>	II(10, 12) IV(1, 7) V(3, 4, 12) VI(5, 7)		
<i>S. ?wrightianus</i>	I(4, 6, 14, 34, 66, 96, 101)		
<i>Spondylus</i> spp.	I(34, 93, 101) V(3)		
<i>Spondylidae</i> sp.	O(1)		
Strombidae			
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<i>S. dilatatus</i>	I(29, 41, 42, 43, 48, 51, 56, 59, 61, 63, 64, 85) II(11) IV(1, 6, 16)		
<i>S. erythrinus</i>	O(H)		
<i>S. vittatus</i>	I(8, 9, 11, 18, 19, 26, 34, 41, 43, 45, 64, 89, 113, 124)		
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Trochidae			
<i>Angaria</i> sp.	VI(14)		
<i>?Clanculus</i> sp.	I(51, 110, 121)		
Vasidae			
<i>Tudicula armigera</i>	I(3, 11) IV(12) VI(4)		
Veneridae			
<i>Antigona lamellaris</i>	I(96, 103) IV(16) VI(4)		
<i>Callanaitis</i> sp.	I(94, 104, 107, 112)		
<i>Dosinia</i> sp.	I(28, 49, 67, 101) V(4, 8)		
Volutidae			
<i>Cymbiola sophia</i>	IV(6)		
<i>Melo</i> sp.	IV(8)		
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<i>Xenophora ?australis</i>	I(11, 29, 35, 42, 48, 94) IV(6, 8, 12, 16) V(9, 14)		
<i>X. cf. australis</i>	II(11, 15) VI(4, 3, 5, 7, 13)		
<i>X. helvocea</i>	I(2)		
<i>Xenophora</i> spp.	O(H) II(2, 7, 13, 15) III(25)		

CRUSTACEA

Alpheidae			
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<i>Aristaeomorpha foliacea</i>	III(2)		
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<i>C. terraereginae</i>	I(4, 18, 49, 57, 64, 67, 77, 97, 104, 105, 106, 107, 120, 122, 123) II(11, 14) V(13) VI(4, 7)		
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Chirostylidae			
<i>Eumunida</i> sp.	III(8, 25)		
Cirolanidae			
<i>Bathynomus</i> sp.	III(7, 8, 24)		
Cymothoidae			
<i>Anilocra</i> sp.	III(6)		
Diogenidae			
<i>Dardanus arrosor</i>	III(14, 15, 21)		
<i>Tricopagurus</i> cf. <i>strigimanus</i>	III(23)		
Dorippidae			
<i>Dorippe frascione</i>	I(58, 97) II(9, 10) IV(6) VI(5)		
Dromiidae			
<i>Cryptodromia</i> sp.	IV(8)		
<i>Dromia intermedia</i>	II(8, 10, 11, 14)		
<i>Dromidiopsis edwardsi</i>	I(51, 59, 63, 92)		
Eryonidae			
<i>Stereomastis phosphorus</i>	III(9, 26)		
Galatheidae			
<i>Galathea elegans</i>	IV(2, 6)		
<i>Munida incerta</i>	III(6, 9)		
<i>M. japonica</i>	III(6, 7, 24)		
<i>M. squamosa</i>	III(7, 8, 9)		
Glyphocrangonidae			
<i>Glyphocrangon</i> cf. <i>regalis</i>	III(6, 7, 25)		
Goneplacidae			
<i>Carcinoplax</i> sp.	III(21)		
<i>Rhizopa gracilipes</i>	I(13, 16)		
Hippolytidae			
<i>Hippolytata</i> sp.	V(12)		
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<i>Arcania undecimspinosus</i>	I(49, 59, 79) III(21)		
? <i>Arcania</i> sp.	I(22)		
<i>Iphiculus</i> sp.	I(18)		
<i>Ixa inermis</i>	I(62, 115, 120)		
<i>Leucosia haswelli</i>	IV(6)		
<i>L. ocellata</i>	I(96, 103, 104, 112)		
<i>Myra</i> ? <i>affinis</i>	I(42, 107)		
Majidae			
<i>Anacinerops stimpsoni</i>	I(113)		
<i>Chlorinoides aculeatus</i>	I(97, 118)		
<i>Chlorinoides</i> sp.	IV(8, 12)		
<i>Cryptomaia</i> ? <i>maccullochi</i>	III(16, 25, 26)		
<i>Hyastenus diacanthus</i>	I(4, 9, 35, 46, 63, 111, 113) IV(1, 7)		
<i>Hyastenus</i> sp.	II(17)		
<i>Leptomithrax waitei</i>	III(2, 7)		
<i>Leptomithrax</i> sp.	III(3)		
<i>Micippa</i> sp.	I(57)		
<i>Naxioides taurus</i>	VI(7)		
<i>Paranaxia serpulifera</i>	I(55, 98, 113, 120)		
<i>Phalangipus australiensis</i>	I(9, 31, 45, 52, 58, 97) II(6, 8) VI(6)		
<i>P. ?hystrix</i>	I(7)		
<i>P. longipes</i>	I(28, 49, 120) V(9)		
<i>Picrocerus armatus</i>	II(9)		
<i>Platymaia wyvillethomsoni</i>	III(7, 25, 26)		
<i>P. fimbriata</i>	III(25, 26)		
<i>Torinia</i> sp.	I(67)		
Majidae sp.	IV(4)		
Pachylasmatidae			
<i>Pachylasma</i> cf. <i>scutistriata</i>	III(25, 26)		
Paguridae			
<i>Clibanarius</i> spp.	I(9, 10, 13, 18, 36, 41, 42, 43, 49, 51, 52, 63, 89, 97, 101) IV(1, 6, 7, 8, 9, 12, 14, 16) VI(5, 6, 7)		
<i>Pagurus</i> ? <i>imbricatus</i>	I(3)		
<i>Pylopagurus</i> sp.	I(19, 20)		
<i>Spiropagurus spiriger</i>	I(4, 19, 28, 35, 42)		
<i>Troglopagurus jousseaumii</i>	I(10, 22)		
Palinuridae			
<i>Limnuparus trigonus</i>	III(2, 7, 23)		
<i>Puerulus</i> sp.	III(23)		
Pandalidae			
<i>Heterocarpus sibogae</i>	III(1, 6, 7, 9, 25, 26)		
<i>H. woodmasoni</i>	III(6, 24)		
<i>Heterocarpus</i> sp.	III(7)		
<i>Parapandalus spinipes</i>	III(8, 15, 19, 22)		
<i>Parapandalus</i> sp.	III(21)		
<i>Plesionika ensis</i>	III(6, 7)		
<i>P. ?longirostris</i>	III(2)		
<i>P. martia</i>	III(2, 6, 7, 8, 9, 19, 25, 26)		
Parapaguridae			
<i>Parapagurus diogenes</i>	III(14)		
<i>P. pilosimanus</i>	III(25, 26)		
<i>Parapagurus</i> sp.	III(21)		
Parthenopidae			
<i>Cryptopodia queenslandi</i>	O(B) I(93, 101, 104, 109, 119, 120, 122)		
<i>Parthenope contrarius</i>	I(29, 45, 51, 64, 105) II(1, 6, 7, 11)		
<i>P. curvispinus</i>	I(45, 100)		
<i>P. ?curvispinus</i>	V(2)		
<i>P. harpax</i>	I(61, 63, 67, 92, 113, 118) IV(1, 12)		
<i>P. longimanus</i>	I(1, 9, 41, 45, 49, 64, 98, 113)		
<i>P. longispinus</i>	I(45) IV(1)		
Penaeidae			
? <i>Macropetasma</i> sp.	III(22)		
<i>Metapenaeopsis lamellata</i>	I(7, 76)		
<i>M. ?rosea</i>	I(1, 7, 9, 10, 13, 16, 18, 19, 22, 28, 30, 31, 32, 35, 36, 38, 39, 42, 44, 45, 51, 56, 58, 65, 67, 71, 76, 94, 95, 97, 99, 102, 103, 104, 105, 106, 107, 113) IV(1, 9) V(9, 12, 14) V(6)		
<i>Metapenaeopsis</i> spp.	I(1, 7)		
<i>Metapenaeus endeavouri</i>	I(18, 37, 38, 39, 40, 69, 75, 76, 77, 78, 79, 80, 82, 83, 84, 85, 86, 100, 104, 106, 109, 110)		
<i>M. ensis</i>	I(100, 104) V(1, 5) VI(2)		
<i>Metapenaeus</i> sp.	V(10)		
<i>Penaeus esculentus</i>	I(36, 44, 48, 58, 69, 75, 76, 77, 78, 79, 80, 82, 83, 84, 85, 86, 93, 97, 104, 106, 108, 115, 120, 124) V(10) VI(3)		
<i>P. latisulcatus</i>	I(84)		

<i>P. longistylus</i>	I(3, 7, 35, 38, 41, 47, 50, 59, 95, 105, 106) VI(4)	<i>Thalamita sexlobata</i>	IV(12)
<i>P. plebejus</i>	I(3, 25, 28, 86) III(9, 11, 14, 15)	<i>T. sima</i>	I(92, 113, 115) V(12)
<i>P. semisulcatus</i>	O(B, C) I(36, 37, 65, 66, 68, 73, 75, 77, 80, 85, 88, 91, 97, 100, 102, 103, 104, 105, 106, 108, 110, 120) V(6) VI(2, 3)	<i>Thalamita</i> sp.	V(1, 6)
<i>Sicyonia ?lancifer</i>	I(7, 63)	Processidae	
<i>Trachypenaeopsis</i> spp.	III(7, 25, 26)	<i>Nikoides</i> sp.	I(18)
<i>Trachypenaeus anchoralis</i>	I(68, 105, 106, 113)	Raninidae	
<i>T. curvirostris</i>	I(1, 7, 34)	<i>Ranina ranina</i>	II(1)
<i>T. granulatus</i>	I(7, 19, 22, 25, 28, 31, 34, 35, 39, 47, 68, 74, 89, 97, 105, 106, 107, 109, 120)	Scalpellidae	
Poecilasmidae		<i>?Anandaleum</i> sp.	III(6)
Poecilasmidae sp.	III(6)	<i>Arcoscalpellum pedunculatum</i>	III(6, 7, 8, 24, 25, 26)
Porcellanidae		<i>Arcoscalpellum</i> sp.	III(6)
<i>Pachycheles sculptus</i>	I(92) V(12)	Scyllaridae	
<i>Porcellana furcillata</i>	V(-)	<i>Ibacus alticrenatus</i>	III(1, 2, 8, 9, 10, 15, 18, 19, 23)
<i>P. suluiensis</i>	V(12)	<i>I. brucei</i>	III(2, 4, 5, 14, 15)
Porcellanidae sp.	VI(4)	<i>Ibacus</i> sp.	III(4)
Portunidae		<i>Scyllarus ?rubens</i>	IV(6)
<i>Benthochascon hemingi</i>	III(6, 25, 26)	<i>S. tuberculatus</i>	I(41, 61, 67, 76, 77, 80, 83, 84, 86, 93, 102, 104, 105, 106) IV(6) V(12)
<i>Charybdis bimaculata</i>	III(11, 22)	<i>Scyllarus</i> spp.	I(9, 18, 19, 28, 34, 39, 42) VI(7)
<i>C. callianassa</i>	I(68, 71, 72, 87, 98, 104)	<i>Thenus orientalis</i>	O(A, B, E) I(27, 36, 37, 40, 51, 57, 73, 78, 83, 91, 93, 94, 100, 102, 103, 104, 106, 110, 111, 119, 124) II(5, 6) IV(15) V(1, 2, 6, 11, 12) VI(2, 3, 5, 7)
<i>C. cruciata</i>	VI(2)		
<i>C. feriatus</i>	I(72, 83)	Solenoceridae	
<i>C. jaubertiensis</i>	I(74, 79) II(5)	<i>Haliporoides</i> sp.	III(7, 8, 24, 25, 26)
<i>C. miles</i>	III(20)	<i>Hymenopenaeus sibogae</i>	III(1)
<i>C. truncata</i>	I(7, 18, 22, 30, 34, 68, 69, 70, 71, 72, 73, 74, 75, 81, 83, 84, 85, 86, 87, 88, 90, 96, 102, 104, 107, 112) IV(16) V(5, 6, 10, 11, 12, 14) VI(1, 2, 3, 6)	<i>Solenoceridae</i> sp.	III(6, 7)
<i>Lupocyclus philippinensis</i>	I(7, 9, 19, 34) IV(6)	Squillidae	
<i>L. rotundatus</i>	I(18, 79, 86, 97, 103, 118) VI(6)	<i>Alima laevis</i>	VI(2)
<i>Podophthalmus vigil</i>	I(72, 76, 85, 119) V(6, 10) VI(2, 3)	<i>Carinosquilla multicaudata</i>	I(7, 25, 47)
<i>Portunus argentatus</i>	O(E) I(4, 5, 7, 8, 9, 10, 13, 18, 19, 21, 22, 23, 28, 29, 30, 31, 34, 38, 42, 45, 103) IV(6, 14) V(9, 13, 14)	<i>Chlorida ?depressa</i>	I(7)
<i>P. gracilimanus</i>	I(47, 64, 69, 72, 76, 77, 80, 81, 85, 95, 97, 101, 102, 105, 106, 107, 111, 112, 120) V(5, 6, 10) VI(3)	<i>C. granti</i>	IV(4, 6)
<i>P. hastatoides</i>	V(10)	<i>Gonodactylus falcatus</i>	IV(2) V(2)
<i>P. orbitosinus</i>	IV(8, 14) V(12)	<i>G. graphurus</i>	I(52, 61, 67) II(6) VI(5)
<i>P. pelagicus</i>	O(K) I(22, 63, 71, 72, 80, 81, 83, 89, 91, 92, 95, 97, 104, 113, 115) V(10)	<i>Harpisquilla raphidea</i>	I(83) V(5) VI(2)
<i>P. rubromarginatus</i>	O(E) I(58, 106, 119) II(8, 10, 11) IV(2) V(12) VI(4, 5)	<i>Kempina</i> cf. <i>mikado</i>	III(2, 9, 11)
<i>P. sanguinolentus</i>	V(10, 11, 12)	<i>Lysiosquilla</i> cf. <i>maculata</i>	VI(7)
<i>P. tenuipes</i>	O(B, E, G, H) I(3, 9, 18, 19, 20, 22, 23, 28, 31, 32, 35, 36, 38, 39, 41, 42, 46, 51, 59, 63, 74, 95, 97, 98, 99, 107, 111, 120) II(5) IV(6, 14) V(3, 9, 11, 12, 13, 14) VI(1, 3, 4, 5, 6, 7)	<i>Odontodactylus cultrifer</i>	VI(5)
<i>Portunus</i> spp.	I(16, 18, 42, 45, 91) IV(14) V(14)	<i>Oratosquilla ?gonypetes</i>	I(22)
		<i>O. woodmasoni</i>	O(B) I(7, 71, 72, 74, 76, 81, 82, 83, 85, 86, 87) VI(10)
		<i>Squilla perpena</i>	
		Stenopodidae	
		<i>Stenopus hispidus</i>	I(31)
		Stylodactylidae	
		<i>Stylodactylus</i> sp.	III(24)
		Xanthidae	
		<i>Actaea savignyi</i>	I(104, 113, 121) IV(12)
		<i>Actaea</i> sp.	IV(1, 7, 12)
		<i>Actumnus pugilator</i>	V(12)
		<i>Liagore rubromaculata</i>	I(76, 87, 97)
		<i>Liomera ?venosa</i>	V(2)
		<i>Lophozozymus pictor</i>	V(2)
		<i>Parapilumnus?</i> sp.	IV(1)
		<i>Pilumnopus</i> sp.	V(12)
		<i>Pilumnus semilanatus</i>	I(50, 55, 92, 97, 121) IV(8)
		<i>Pilumnus</i> spp.	I(4, 50, 63, 89, 92) II(1, 3, 6, 7, 8, 11) IV(5, 6, 8) V(12) VI(4)
		<i>Zalasius dromiaeformis</i>	I(97)
		<i>Xanthidae</i> sp.	I(92) V(2) VI(1)

ECHINODERMATA

Acanthasteridae			Colobometridae	
<i>Acanthaster brevispinus</i>	II(14)		<i>Colobometra bella</i>	O(J)
<i>A. planci</i>	IV(2) VI(6)		<i>Iconometra anisa</i>	V(9)
Amphiuridae			Comasteridae	
<i>Amphiura</i> sp.	III(26)		<i>Capillaster multiradiatus</i>	VI(7)
Antedonidae			<i>C. sentosus</i>	I(120)
<i>?Euantedon tahitiensis</i>	I(113, 118)		<i>Comantheria</i> cf. <i>grandicalyx</i>	II(11)
<i>Toxometra paupera</i>	VI(3)		<i>C. rotula</i>	O(E, F) II(5, 7, 11, 13) IV(4, 7) V(2)
Asteriidae			<i>C. cf. rotula</i>	II(5, 14)
<i>Pedicellaster</i> sp.	III()		<i>Comantheria</i> sp.	I(11, 56, 58, 60)
Asterinidae			<i>Comanthina belli</i>	I(97, 118)
<i>Anseropoda rosacea</i>	IV(4)		<i>C. schlegeli</i>	II(3, 7) IV(1)
<i>Nepanthia belcheri</i>	I(2)		<i>Comanthus bennetti</i>	I(14)
<i>N. brevis</i>	VI(7)		<i>C. parvicirrus</i>	I(22) II(3, 5, 11, 15)
<i>N. ?variabilis</i>	V(3)		<i>C. samoanus</i>	V(9)
<i>?Nepanthia</i> sp.	III(26)		<i>Comaster</i> sp.	O(E, I)
<i>?Parasterina</i> sp.	III(25)		<i>Comatella maculata</i>	I(27)
Asteroschematidae			<i>C. nigra</i>	I(56, 58, 60, 61, 63) II(7, 14, 17) IV(7) VI(5)
<i>Ophiocreas sibogae</i>	III(20)		<i>C. pectinata</i>	II(4, 5, 7, 11, 12, 14, 15, 17) V(2) VI(6)
Astrometridae			<i>C. purpurea</i>	O(E, F) I(14, 35, 51, 60, 85, 86, 94, 102) II(4, 5, 7, 11, 12, 13, 14, 17) IV(4, 5, 6) V(2, 9) VI(5, 7)
<i>Pterometra venusta</i>	I(10, 16, 18, 36, 45, 52, 66, 90, 97, 100, 113, 118) II(15, 17) VI(5, 6, 7)		<i>C. cf. purpurea</i>	II(2, 7, 12, 13, 14, 17) V(3, 4, 9)
Astropectinidae			<i>C. rotalaria</i>	O(E, F) I(2, 4, 5, 7, 9, 10, 11, 13, 16, 18, 20, 22, 24, 25, 28, 29, 32, 34, 42, 44, 45, 46, 52, 54, 66, 90, 92, 94, 118) IV(2, 3, 16) V(12) VI(3, 4, 5, 6, 7)
<i>Astropecten monacanthus</i>	VI(8)		<i>C. solaris</i>	I(2, 8, 9, 11, 16, 35, 42, 45, 52, 53, 60, 85, 118) VI(—)
<i>A. ?phragmorus</i>	V(9)		<i>C. stelligera</i>	II(6, 11, 17) VI(5)
<i>A. pulcherrimus</i>	I(51, 107)		<i>C. ?stelligera</i>	V(9)
<i>A. cf. schayeri</i>	III(1, 26)		<i>Comissia hartmeyeri</i>	II(7)
<i>A. zebra</i>	O(B, H) I(4, 6, 7, 8, 18, 26, 29, 31, 32, 35, 43, 44, 45, 46, 51, 52, 89, 94, 97, 101, 102, 107, 123) II(2, 14) IV(1, 6, 7, 12, 14) V(3, 4, 12) VI(4, 6, 7, 4)		<i>Comissia</i> sp.	I(5)
<i>A. cf. zebra</i>	II(6)		Cucumariidae	
<i>Astropecten</i> sp.	III(25, 26)		<i>Orbithyone megapodia</i>	IV(1, 7, 12) VI(4, 5)
<i>Psilaster acuminatus</i>	III(1, 24)		<i>Pentacta anceps</i>	I(46, 56, 58, 61, 63, 92, 97, 101, 104, 105, 106, 107, 113, 117, 118) IV(7, 12) VI(5)
Bathycrinidae			<i>P. cf. anceps</i>	II(2, 11)
<i>Metacrinus</i> cf. <i>nobilis</i>	III(19)		<i>P. australis</i>	V(2)
Caudinidae			<i>P. crassa</i>	II(2)
<i>?Acaudina</i> spp.	V(1, 10)		<i>P. quadrangularis</i>	I(63, 74, 103, 104, 105, 113)
Charitometridae			<i>Pentacta</i> sp.	IV(1)
<i>Charitometridae</i> sp.	III(—)		<i>Pseudocolochirus axiologus</i>	I(25, 104, 106) IV(1) V(5)
Chiridotidae			<i>Pseudocolochirus</i> sp.	VI(4, 5)
<i>Chiridotidae</i> sp.	III(1)		<i>Stolus buccalis</i>	V(2)
Cidaridae			<i>S. cf. buccalis</i>	VI(5)
<i>Eucidaris ?metularia</i>	V(9)		<i>Thyone okeni</i>	I(105)
<i>Goniocidaris mikado</i>	III(10)		<i>Thyone</i> sp.	IV(2)
<i>Histocidaris australiae</i>	III(25)		Cucumariidae sp.	
<i>H. elegans</i>	III(26)			II(13)
<i>Histocidaris</i> sp.	III(25, 26)		Diadematidae	
<i>Prionocidaris baculosa</i>	V(9)		<i>Astropyga radiata</i>	O(E)
<i>P. bispinosa</i>	I(9, 11, 24, 70, 86, 89, 94, 101, 103, 109, 113, 118) II(7, 12, 14, 17) IV(1, 2, 4, 5, 6, 7) V(2, 12, 13) VI(5, 13)		<i>Chaetodiadema granulatum</i>	I(2, 22, 26, 29, 46, 51, 69, 72, 83) IV(14) V(4, 13) VI(3, 5, 6, 7, 13)
<i>Stereocidaris</i> cf. <i>microtuberculata</i>	III(26)		<i>Echinothrix calamaris</i>	II(7)
<i>Stylocidaris bracteata</i>	III(14, 23, 25, 26)		Echinasteridae	
<i>S. conferta</i>	III(5, 15, 19)		<i>Echinaster acanthodes</i>	I(1)
<i>Stylocidaris</i> sp.	V(2)		<i>E. luzonicus</i>	V(4)
Clypeasteridae			<i>E. cf. purpureus</i>	II(12, 13)
<i>Clypeaster</i> cf. <i>fervens</i>	III(1)		<i>?Echinaster</i> spp.	III(10, 14)
<i>C. reticulatus</i>	I(2, 43) V(9)			
<i>C. telurus</i>	II(3, 6, 11, 12, 13, 14)			
<i>Clypeaster</i> sp.	II(6, 12)			

Echinothuriidae			
<i>Araeosoma</i> cf. <i>owstoni</i>	III(5, 14, 26)		<i>Peronella</i> ? <i>orbicularis</i>
<i>Asthenosoma intermedium</i>	II(11)		
<i>A. varium</i>	II(5) V(3, 9, 12)		Loveniidae
<i>Hygrasoma</i> cf. <i>hoplocantha</i>	III(23)		<i>Lovenia doederleini</i>
<i>Phormosoma</i> cf. <i>rigidum</i>	III(14, 25, 26)		<i>L. elongata</i>
Euryalidae			
<i>Euryale aspera</i>	I(46, 98) II(4, 5, 7, 11, 13, 14, 15, 17)		Luidiidae
			<i>Luidia hardwicki</i>
			<i>L. maculata</i>
Goniasteridae			
<i>Anthea crassa</i>	* I(51, 61, 120)		Mariametridae
<i>A. ?crassa</i>	V(2, 12)		<i>Lamprometra klunzingeri</i>
<i>A. cf. crassa</i>	II(12, 13)		<i>Liparmetra articulata</i>
<i>A. cf. elegans</i>	II(7)		<i>Oxymetra erinaceus</i>
<i>A. mertoni</i>	O(F)		<i>Stephanometra indica</i>
? <i>Anthea</i> sp.	II(15)		Mariametridae sp.
<i>Goniiodiscaster australiae</i>	I(83)		
<i>G. pleyadella</i>	I(9) IV(1, 12)		Metrodiridae
<i>G. rugosus</i>	II(14, 15, 17)		<i>Metrodira subulata</i>
<i>Iconaster longimanus</i>	I(6) II(3, 6, 11, 12, 13, 14) IV(1, 2, 12) VI(5)		
			Molpadiidae
<i>Mediaster australiensis</i>	III(25)		Molpadiidae sp.
<i>Mediaster</i> spp.	III(7, 24, 26)		
<i>Nymphaster moebi</i>	III(26)		Ophiaetidae
<i>N. pentagonus</i>	III(7, 26)		<i>Ophiadaphne materna</i>
<i>Nymphaster</i> sp.	III(24)		
<i>Pseudogoniaster wardi</i>	II(2)		Ophidiasteridae
<i>Stellaster equestris</i>	O(B) I(1, 2, 4, 9, 24, 33, 42, 43, 44, 45, 46, 50, 52, 56, 57, 58, 63, 71, 74, 81, 85, 86, 92, 97, 98, 101, 102, 119, 124) II(11) IV(2, 3, 7, 14) V(2, 13) VI(4, 5, 7)		<i>Certonardoa carinata</i>
			<i>Leiaster glaber</i>
			cf. <i>Linkia</i> sp.
			<i>Nardoa gomophia</i>
			<i>Nardoa</i> sp.
			<i>Tamaria dubiosa</i>
			<i>T. fusca</i>
			<i>T. megaloplax</i>
<i>S. cf. incei</i>	II(2, 6, 14, 15, 16)		? <i>Tamaria</i> sp.
<i>S. cf. inspinosus</i>	III(8, 10, 25, 26)		
<i>Stellaster</i> sp.	III(20, 22)		Ophiidermatidae
Goniasteridae spp.	III(3, 10)		<i>Cryptopella granulifera</i>
Himerometridae			<i>Ophiarachnella gorgonia</i>
<i>Amphimetra ensifera</i>	IV(2)		<i>O. infernalis</i>
<i>Heterometra</i> cf. <i>crenulata</i>	II(7, 11)		<i>O. similis</i>
<i>H. quinduplicava</i>	IV(2)		<i>O. spheisci</i>
<i>H. variipinna</i>	O(E, F, G, K) IV(1, 2, 3, 6)		<i>Ophioclasma stellatum</i>
<i>Himerometra magnipinna</i>	V(9)		
Holothuriidae			<i>Ophiopsammus yoldii</i>
<i>Actinopyga echinites</i>	I(56, 62) VI(4)		
<i>A. cf. echinites</i>	II(16)		Ophiotrichidae
<i>A. cf. miliaris</i>	II(4, 11, 12)		<i>Macrophiothrix koelheri</i>
<i>Bohadschia</i> cf. <i>argus</i>	II(3)		<i>M. megapoma</i>
<i>B. cf. marmorata</i>	II(5, 15) IV(14)		<i>Macrophiothrix</i> sp.
<i>Bohadschia</i> sp.	O(5)		? <i>Ophiocnemis marmorata</i>
? <i>Bohadschia</i> sp.	V(9)		? <i>Ophiocnemis</i> sp.
<i>Holothuria edulis</i>	IV(1) VI(5)		
<i>H. cf. leucaspilota</i>	II(12)		<i>Ophiomaza cacaotica</i>
<i>H. martensi</i>	I(49, 52, 56, 61, 64, 74, 81, 82, 83, 84, 101, 107, 109) IV(1, 3, 12)		
			<i>Ophioperteron elegans</i>
<i>H. ocellata</i>	I(7, 13, 24, 28, 36, 49, 84, 85, 91, 97, 107, 110, 113) IV(14) VI(4, 5, 7, 2, 3, 8)		<i>Ophiotrix ciliaris</i>
			<i>O. foveolata</i>
<i>Holothuria</i> cf. <i>pervicax</i>	I(2, 101) II(11, 12) VI(5)		<i>O. melanostica</i>
<i>Holothuria</i> spp.	II(13) III(15) V(3, 9)		<i>O. martensi</i>
Laganidae			
<i>Laganum depressum</i>	I(85) II(15) VI(14)		<i>O. miles</i>
<i>Peronella lesueurii</i>	O(D) I(2, 4, 9, 24, 46, 51, 56, 57, 62, 84, 90, 94, 113, 124) IV(1, 4, 14) V(3) VI(3, 4)		<i>O. nereidina</i>
			<i>O. ?nereidina</i>
			<i>O. propinqua</i>
			<i>O. cf. proteus</i>
			<i>O. purpurea</i>
			<i>O. cf. scotiosa</i>
<i>P. orbicularis</i>	IV(1, 6, 7, 8, 14, 16) V(4, 13) VI(4, 11)		<i>O. ?viselandi</i>
			<i>Placophiothrix melanosticata</i>

Bothidae			
<i>Arnoglossus intermedius</i>	O(B, E, G, I) I(29, 32, 35, 46, 58, 59, 60, 114) IV(-) V(9, 12) VI(1, 5, 7) I(9, 18, 19, 22, 29) V(4, 13) I(88, 99) I(10, 18) III(6, 8, 23, 24) III(11) I(1, 3, 6, 7, 8, 10, 11, 17, 29, 32, 41, 53, 56, 57, 58, 60, 62, 64, 67, 92, 94, 112) II(3, 5, 12, 13) IV(-) V(9, 12, 13) VI(3, 4, 5) O(B, I) II(1, 2, 5, 11, 12) VI(5) I(2, 11, 17, 18, 19, 29, 30, 32, 35, 41, 42, 44, 46, 50, 54, 67, 92, 94, 101, 109) IV(-) V(12) VI(3, 5) III(10) I(60, 113, 114) I(4, 10, 11, 14, 17, 18, 19, 30, 32, 41, 42, 46, 47, 49, 50, 67, 92) IV(-) V(3, 6, 12, 13, 14) VI(2, 3, 5) I(5, 20) II(5, 12, 16, 17) III(21, 22) VI(7) O(B, E, F, G, I) I(4, 9, 10, 11, 13, 17, 18, 19, 20, 22, 23, 29, 30, 31, 32, 35, 36, 41, 42, 44, 46, 47, 49, 50, 52, 62, 65, 67, 72, 73, 78, 87, 94, 95, 99, 100, 104, 106, 115, 122, 124) V(1, 5, 8, 10, 13, 14) VI(1, 2, 3, 5, 6, 7) I(4, 9, 10, 11, 18, 67, 69, 78, 86, 89, 94, 113, 123, 124) IV(-) V(5, 13) VI(3, 5) I(57, 60, 89, 113) III(3, 11) III(11) I(32, 67, 72, 92, 104, 107, 115, 117, 123) V(12) VI(3, 4) III(6, 8, 23, 24) III(11, -) I(41, 67, 92) V(4, 12, 14) VI(3) I(57) II(10, 17) I(98, 105) I(45, 120) III(2, 3, 4, 5, 10, 22) III(8, 10) VI(3) VI(-) I(83) I(40) V(6) V(10) VI(2) III(3, 11) VI(1) V(5, 10) VI(1, 2) VI(2) I(68)		
<i>A. tapeinosoma</i>			
<i>A. waitei</i>			
<i>Arnoglossus</i> spp.			
<i>Chascanopsetta lugubris</i>			
<i>Citharoides</i> sp.			
<i>Engyprosopon</i>			
<i>grandisquama</i>			
<i>Grammatobothus pennatus</i>			
<i>G. polyophthalmus</i>			
<i>Poecilopsetta</i> sp.			
<i>Pseudorhombus argus</i>			
<i>P. diplospilus</i>			
<i>P. dupliciocellatus</i>			
<i>P. elevatus</i>			
<i>P. spinosus</i>			
<i>Pseudorhombus</i> sp.			
Branchiostegidae			
<i>Branchiostegus serratus</i>			
Callionymidae			
<i>Bathycallionymus mortonensis</i>			
<i>Calliurichthys grossi</i>			
<i>Chascanopsetta</i> sp.			
<i>Citharoides ?macrolepis</i>			
<i>Dactylopus dactylopus</i>			
<i>Orbonnymus rameus</i>			
<i>Repomucenus belcheri</i>			
<i>R. calcaratus</i>			
Caproidae			
<i>Antigonia rubicunda</i>			
<i>Antigonia</i> sp.			
Carangidae			
<i>Alepes apercna</i>			
<i>A. mate</i>			
<i>Carangoides armatus</i>			
<i>C. chrysophrys</i>			
<i>C. diversa</i>			
<i>C. equula</i>			
<i>C. hedlandensis</i>			
<i>C. malabaricus</i>			
<i>Carangoides</i> sp.			
<i>Caranx bucculentus</i>			
<i>C. humerosus</i>			
<i>Megalaspis cordyla</i>			
<i>Scomberoides tala</i>			
<i>S. tol</i>			
<i>Selar crumenophthalmus</i>			
<i>Selaroides leptolepis</i>			
<i>Seriolina nigrofasciata</i>			
Carapidae			
<i>Pyramodon ventralis</i>			
Carcharinidae			
<i>Mustelus antarcticus</i>			
Centriscidae			
<i>Centriscus scutatus</i>			
Chaetodontidae			
<i>Parachaetodon ocellatus</i>			
Chauliodontidae			
<i>Chauliodus</i> sp.			
Chaunacidae			
<i>Chaunax</i> sp.			
Chimaeridae			
<i>Hydrolagus</i> sp.			
Chirocentridae			
<i>Chirocentrus dorab</i>			
Chlorophthalmidae			
<i>Chlorophthalmus</i> spp.			
Congridae			
<i>Ariosoma</i> sp.			
Cynoglossidae			
<i>Cynoglossus</i> sp.			
Dactylopteridae			
<i>Dactyloptena orientalis</i>			
<i>D. papilo</i>			
Dasyatidae			
<i>Gymnura australis</i>			
<i>Urolophus</i> sp.			
Diodontidae			
<i>Tragulichthys jaculiferus</i>			
Dussumieriidae			
<i>Dussumieria hasselti</i>			
Fistulariidae			
<i>Fistularia commersonii</i>			
<i>F. petimba</i>			
Gerridae			
<i>Gerres filamentosus</i>			
<i>G. macracanthus</i>			
<i>Pentaprius longimanus</i>			
Gobiidae			
<i>Acentrogobius ornatus</i>			
<i>Ctenogobius criniger</i>			
<i>Oxyurichthys</i> sp.			
Grammicolepidae			
<i>Xenolepidichthys dalgleishi</i>			
Hemiramphidae			
<i>Hemiramphus</i> sp.			
Hexanchidae			
<i>Heptanchias perlo</i>			
Holocentridae			
<i>Ostichthys cf. japonicus</i>			
Hoplichthyidae			
<i>Hoplichthys citrinus</i>			
Labridae			
<i>Choerodon cephalotes</i>			
<i>C. viita</i>			
<i>Choerodon</i> spp.			

	29, 51, 67, 89, 110) II(1, 4, 5) IV(-) V(1, 3, 4, 8, 9, 12, 13, 14) VI(3, 4, 6) I(6)	Nemipteridae <i>Nemipterus ?aurifilum</i> I(104) <i>N. hexodon</i> VI(3) <i>N. peronii</i> O(B) <i>Nemipterus</i> spp. I(7, 18, 19, 22, 36, 39, 40, 68, 69, 72, 73, 74, 75, 77, 78, 80, 83, 86, 87, 104, 105) V(1, 3, 4, 5, 6, 10, 12, 11, 13, 14) VI(1, 3) <i>Pentapodus paradiseus</i> I(57, 89) IV(-) <i>Scolopsis taeniopterus</i> I(36, 84, 104, 120) V(4, 12) VI(2, 3)
<i>Pseudolabrus gracilis</i>		Ogcocephalidae <i>Halicometus reticulatus</i> III(25) <i>Halieutaea</i> sp. III(2, 4, 5, 6, 7, 14, 23) <i>Malthopsis</i> sp. III(1, 22)
Leiognathidae		Ophidiidae <i>Glyptophidium</i> sp. III(6, 8) <i>Hoplobrotula</i> sp. III(1, 8, 23)
<i>Leiognathus bindus</i>	I(40, 104) V(3, 5, 6, 10, 12, 13) VI(1, 2, 3, 4) I(40, 72, 104) V(1, 12) I(69, 70, 71, 72, 73, 74, 76, 77, 78, 79, 80, 81, 82, 87, 88) O(A, B, C) V(14)	Ostraciontidae <i>Lactoria cornuta</i> I(83, 86) <i>Rhinosomus gibbosus</i> I(3) VI(-) <i>Rhynchostracion nasus</i> I(78, 81, 83, 84, 105, 106) II(10) VI(3, 4)
<i>L. leuciscus</i>		Pegasidae <i>Zalises draconis</i> II(14)
<i>L. cf. leuciscus</i>		Platacidae <i>Platax</i> sp. VI(3, 4, 6)
<i>L. splendens</i>		Platycephalidae <i>Bambradon laevis</i> III(8) <i>Bembras ?japonicus</i> III(15, 23) <i>Elates thompsoni</i> I(40, 72, 88, 90) V(6, 10) VI(2) <i>Onigocia</i> sp. IV(-) VI(7) <i>Platycephalus indicus</i> O(C, E) <i>Rogadius asper</i> IV(-) V(12) VI(7) <i>Rogadius</i> sp. I(7, 8, 9, 18, 19, 22, 29) <i>Suggrundus diversidens</i> III(1, 2, 3, 5, 10, 15) <i>S. isacanthus</i> I(22, 29, 32, 45, 58, 70, 71, 78, 79, 105, 112) IV(-) V(12) VI(7) <i>S. macracanthus</i> I(1, 4, 16, 19, 25, 36, 67, 70, 78, 80, 94) V(1, 3, 5, 6, 8, 10, 13, 14) VI(3) <i>S. tuberculatus</i> I(7, 18, 25, 30, 32, 34, 39, 45, 61, 62, 112) II(16) IV(-) V(9, 12) VI(-) <i>Suggrundus</i> sp. O(E) I(36) III(8, 11, 15, 19, 22, 23) IV(-) V(9, 12) VI(7)
<i>Lethrinidae</i>		Plectorhynchidae <i>Diagramma pictum</i> V(11, 13)
<i>Lethrinella nematacantha</i>	O(B) I(14, 61, 112) II(13) V(12)	Plesiopidae <i>Plesiops</i> sp. II(5, 12, 16, 17)
Lophiidae		Pleuronectidae <i>?Paralichthys</i> sp. III(6, 7, 8, 25, 26) <i>Samaris cactatae</i> I(7, 9) II(11) V(8, 12) VI(5)
<i>Lophiodes cf. mutilus</i>	III(6, 7, 8, 9, 26)	Plotosidae <i>Euristhmus elongatus</i> I(18, 19, 22, 70, 71, 72, 82, 106, 107)
<i>Lophiomus setigerus</i>	III(5, 15)	Polymixidae <i>Polymixia cf. japonicus</i> III(10)
Lutjanidae		Polynemidae <i>Polynemus multiradiatus</i> I(72)
<i>Lutjanus sanguineus</i>	V(1, 5) VI(-)	Pomacanthidae <i>Chaetodontoplus personifer</i> IV(-)
<i>L. sebae</i>		Pomacentridae <i>Pristotis jerdoni</i> I(22, 89) II(3, 7, 11, 12, 13, 15) V(3, 4, 9, 12, 13) VI(-)
Macrorhamphosidae		
<i>Macrorhamphosus mollerii</i>	III(3, 4, 10)	
Macrouridae		
<i>Coelorhynchus cf. mirus</i>	III(1, 2, 8, 19)	
<i>Coelorhynchus</i> sp.	III(6, 7, 8, 19, 23, 25) III(10)	
<i>Coryphaenoides</i> sp.	III(10)	
<i>Hymenocephalus cf. longiceps</i>	III(6, 7, 26)	
<i>Malacocephalus laevis</i>	III(6, 26)	
<i>Neuzumia</i> sp.	III(6, 7, 9, 25, 26)	
Monacanthidae		
<i>Brachaleuteres</i> sp.	IV(-) V(12)	
<i>Chaetoderma penicilligera</i>	II(14)	
<i>Paramonocanthus oblongus</i>	I(3, 41, 68, 89, 100, 104, 117, 120) V(12, 13) I(2, 6, 7, 28, 59, 67, 82, 83, 86, 89, 92, 94, 104, 117, 120, 122, 123, 124) II(1, 3, 11, 14, 15, 16) V(5, 8, 9, 10) I(51) III(5, 14) III(11)	
<i>Paramonocanthus</i> sp.		
<i>Pseudomonocanthus peroni</i>		
<i>Thamnoconus hypargyreus</i>		
<i>T. tessellatus</i>		
Monocentridae		
<i>Cleidopus gloriamaris</i>	I(7)	
Moridae		
<i>Euclichthys polynemus</i>	III(19)	
<i>Physiculus cf. nigrescens</i>	III(8, 23)	
Mugiloididae		
<i>Parapercis emeryana</i>	IV(-) V(9, 12) VI(7)	
Mullidae		
<i>Upeneus filifer</i>	IV(-)	
<i>U. sulphureus</i>	I(40) V(1, 5, 6, 10) VI(1, 2)	
<i>U. sundiacus</i>	I(74, 76, 78, 80, 83, 85, 87, 92, 104) V(1, 6) VI(3) I(78, 92) O(A, B, C, D, E) I(46, 57, 61, 84, 89) IV(-) VI(4) V(9, 12, 13)	
<i>U. tragula</i>		
<i>U. vittatus</i>		
<i>Upeneus</i> spp.		
Muraenesocidae		
<i>Muraenesox bagio</i>	III(-)	
<i>M. cinereus</i>	I(80, 83) V(10)	
Muraenidae		
<i>Lycodontis undulatus</i>	I(81, 92)	
Myctophidae		
<i>Diaphus</i> sp.	III(6, 8)	
Myriidae		
<i>Muraenichthys</i> sp.	I(72)	

Pomadasyidae			
<i>Pomadasyus argyreus</i>	I(68, 72, 83) V(1, 5, 10)		
	VI(2)		
<i>P. maculatus</i>	I(71, 74, 82)		
Priacanthidae			
<i>Priacanthus tayenus</i>	O(B) I(40, 76, 79, 81, 83)		
	V(1, 5, 10, 11, 13) VI(2, 3, 4)		
Pristiophoridae			
<i>Pristiophorus nudipinnis</i>	III(-)		
Psettodidae			
<i>Psettodes erumei</i>	O(B) I(13, 36, 40, 70, 72, 73, 77, 81, 87) V(5, 10) VI(2, 3, 5)		
Pseudochromidae			
<i>Pseudochromis quinquedentatus</i>	I(40, 58, 64, 89)		
<i>Pseudochromis</i> sp.	II(5)		
Rajidae			
<i>Raja</i> sp.	III(1, 3, 5, 7, 9, 11, 14, 15, 19, 25, 26)		
<i>Pammohatis waitii</i>	III(7, 25)		
Rhinobatidae			
<i>Rhina ancylostomus</i>	VI(-)		
Sciaenidae			
<i>Austronithea oedogenys</i>	I(73)		
<i>Johnius vogleri</i>	I(68)		
Scorpaenidae			
<i>Adventor elongatus</i>	I(74)		
<i>Apistops caloundra</i>	VI(3)		
<i>Brachirus miles</i>	I(18, 60)		
<i>Brachirus</i> sp.	V(9)		
<i>Dendrochirus brachypterus</i>	II(3) VI(5)		
<i>D. zebra</i>	IV(-)		
<i>Erosa erosa</i>	II(10, 13, 14)		
<i>Helicolenus papillosus</i>	III(2)		
<i>Hypodytes carinatus</i>	I(25, 69, 70, 74, 75, 80, 83, 85, 92, 106) IV(-) VI(3)		
<i>Inimicus caledonicus</i>	I(1) II(7, 10) IV(-)		
<i>Liocranium scorpio</i>	I(124)		
<i>Lioscorpius</i> spp.	III(10, 19)		
<i>Minous trachycephalus</i>	I(7, 18, 19, 22, 30, 81)		
<i>M. versicolor</i>	I(25, 68, 76, 79, 105) VI(5)		
<i>Neosebastes incisipinnis</i>	III(4, 7)		
<i>N. cf. nigropunctatus</i>	III(8, 11, 14, 15)		
<i>Paracentropogon vespa</i>	I(68, 72, 76, 78, 80, 85, 92, 118)		
<i>Paraploactis</i> sp.	IV(-)		
<i>Pterois volitans</i>	I(18)		
<i>Scorpaena ergastulorum</i>	III(1, 3, 8)		
<i>Scorpaenopsis</i> spp.	I(64, 66, 84, 92) IV(-)		
<i>Setarches guentheri</i>	III(6, 7, 9)		
<i>Scorpaenidae</i> sp.	III(10)		
Scyliorhinidae			
<i>Halaehurus analis</i>	III(10)		
<i>Cephaloscyllium isabella</i>	III(-)		
<i>Galeus boardmani</i>	III(8, 10, 19, 25)		
Serranidae			
<i>Cephalopholis pachycentron</i>	IV(-)		
<i>Chelidoperna</i> sp.	I(2)		
<i>Epinephelus sexfasciatus</i>	I(47, 67, 81, 88, 89, 104, 117, 118) V(1) VI(-)		
Sillaginidae			
<i>Sillago maculata</i>	VI(2, 3, 4)		
Soleidae			
<i>Aseraggodes</i> sp.	III(19, -)		
<i>Synaptura muelleri</i>	I(49, 74, 75, 90, 107)		
<i>S. quagga</i>	I(72)		
Solenichthyidae			
<i>Solenostomus</i> sp.	IV(-)		
Sphyrinaeidae			
<i>Sphyræna forsteri</i>	VI(3)		
Squalidae			
<i>Centrophorus scalpratus</i>	III(1, 2)		
<i>Etmopterus lucifer</i>	III(2)		
<i>Squalus megalops</i>	III(-)		
<i>Squalus</i> sp.	III(7, 10, 19, 23, 26)		
Squatinaeidae			
<i>Squatina australis</i>	III(3, 19)		
<i>S. tergocellata</i>	III(-)		
Syngnathidae			
<i>Halicampus grayi</i>	I(59, 61, 63, 113)		
<i>Hippocampus whitei</i>	I(28) II(10) VI(-)		
Synodontidae			
<i>Saurida filamentosus</i>	III(11)		
<i>S. micropectoralis</i>	V(10)		
<i>S. tumbil</i>	O(B) I(2, 17, 18, 20, 47, 50, 51, 68, 69, 70, 71, 72, 78, 87, 104, 106) V(1, 5, 6, 8, 10, 11, 12, 13, 14) VI(1)		
<i>S. undosquamis</i>	O(A, B, C, I) I(2, 4, 5, 10, 11, 13, 14, 17, 20, 22, 23, 25, 36, 37, 41, 47, 50, 51, 53, 54, 64, 67, 68, 72, 75, 80, 87, 100, 104, 110, 115, 117, 118, 124) V(4, 5, 6, 8, 10, 12, 13, 14) VI(1, 2, 3, 4, 5)		
<i>Synodus houli</i>	V(9)		
<i>S. similis</i>	I(5, 6, 10, 17, 23, 54, 55, 89) II(13, 16) IV(-) V(4) VI(3, 4, 5)		
<i>S. variegatus</i>	I(92) V(9, 12, 13, 14) VI(3)		
<i>Trachinocephalus myops</i>	I(7) V(9, 12, 13, 14)		
Tetraodontidae			
<i>Amblyrhynchotes spinosissimus</i>	III(10, 11)		
<i>Anchisomus multistriatus</i>	II(12, 13) VI(4)		
<i>A. pachygaster</i>	III(2, 3, 4, 5, 14, 15)		
<i>Canthigaster bennetti</i>	I(112)		
<i>C. rivulata</i>	II(2)		
<i>C. valentini</i>	IV(-)		
<i>Canthigaster</i> spp.	I(7) V(4) VI(7)		
<i>Gastrophysus sceleratus</i>	I(7, 39, 112) V(5, 10) VI(2, 3, 4)		
<i>G. spadiceus</i>	O(A) I(83) V(10) VI(1)		
<i>Lagocephalus</i> sp.	III(15)		
<i>Torquigener pallimaculatus</i>	IV(-)		
<i>T. tuberculiferus</i>	IV(-) VI(4)		
<i>T. whiteyi</i>	I(2, 50, 74, 82, 83, 102, 106, 110) III(5) VI(2)		
Teraponidae			
<i>Pelates quadrilineatus</i>	I(78, 81)		
<i>Terapon theraps</i>	I(40, 71, 72, 83, 87, 104) V(1, 6, 10, 12) VI(1, 2)		
Torpedinidae			
<i>Narcine tasmaniensis</i>	III(8, 23)		
<i>Narcine</i> sp.	III(8, 11)		
<i>Torpedo macneilli</i>	III(1, 2, 7)		
Triacanthidae			
<i>Tripodichthys angustifrons</i>	I(72, 78, 81, 83, 86, 87) V(10) VI(2, 3, 4)		
Triacanthodidae			
<i>Bathypylax bombifrons</i>	III(18, 19)		
<i>B. omen</i>	III(7, 8)		
<i>Halimachirurgus alcocki</i>	III(6, 8, 9, 25, 26)		
<i>Macrorhamphosodes uradoi</i>	III(6, 7, 8, 10, 25, 26)		
<i>Paratriacanthodes</i> cf. <i>herrei</i>	III(10, 19)		
<i>P. cf. retrospinis</i>	III(6)		

<i>Triacanthodes</i> sp.	III(11, 15, 22)	<i>Pterygotrigla picta</i>	III(1, 3, 10, 25)
Triglidae		<i>Pterygotrigla</i> sp.	III(5, 7)
<i>Chelidonichthys kumu</i>	III(5)	Uranoscopidae	
<i>Lepidotrigla calodactyla</i>	I(11, 17, 19, 25, 36, 41, 47, 54, 58, 92, 94) V(12)	<i>Uranoscopus cognatus</i>	II(12)
		Zeidae	
<i>L.</i> cf. <i>calodactyla</i>	II(3, 4, 11)	<i>Cyttopsis roseus</i>	III(10)
<i>Lepidotrigla</i> sp.	III(3, 4, 6, 11, 14, 15, 23)	<i>Zenion</i> cf. <i>japonicus</i>	III(5, 24, 25)
<i>Peristedion</i> sp.	III(1, 2, 3, 7, 8, 9, 10, 11, 14, 23, 25, 26, 19)	<i>Zenopsis nebulosus</i>	III(3, 5)
		<i>Zeus faber</i>	III(5)

NEW RECORDS OF *ACARNUS* GRAY (PORIFERA: DEMOSPONGIAE: POECILOSCLERIDA) FROM AUSTRALIA, WITH A SYNOPSIS OF THE GENUS

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ABSTRACT

Five species of *Acarnus* are now known for Australian waters. *Acarnus thielei*, *A. innominatus*, *A. tortilis*, and *A. ternatus* are redescribed from recent northern Australian material, three of which represent new locality records for this region. *Acarnus tenuis* from southern Australia is poorly known, and apparently the type-specimens no longer exist. A redescription of *A. ternatus* and *A. topsenti* based on type-material, and a synopsis of other species is given, including diagnoses from the literature. Twelve species are recognised. A cladistic analysis of *Acarnus* species supports the abandonment of a generic subdivision based mainly on the presence or absence of acanthostyles (subgenus *Acanthacarnus*), in favour of a taxonomy based mainly on cladotylote morphology. Four species groups are recognized on that basis: *ternatus*, *tortilis*, *souriei* and *innominatus* groups. The zoogeography of species is discussed.

INTRODUCTION

The marine sponge genus *Acarnus* is easily diagnosed on account of the unique cladotylote megascleres, but specific identifications based on morphological characters are less easily made.

The present study redescribes material collected recently from northern Australian waters, including three new records for the region, and provides a synopsis from the literature of all species currently placed in the genus.

The genus is cosmopolitan, with records from most oceans and seas, although species of the nominal subgenus *Acanthacarnus* have been recorded mainly from the northern hemisphere. Species are found predominantly in shallow-water, but one species from California has an extensive bathymetric distribution extending from the intertidal zone to a depth of 700 metres (de Laubenfels 1932). Previous records of the genus from Australia are restricted to *A. tenuis* Dendy from Port Phillip, Victoria and *A. ternatus* Ridley from Torres Strait, northern Queensland.

METHODS

Methods of collection, preservation and preparation of specimens for light microscopy are described elsewhere (Hooper 1984).

The following abbreviations are used in the text, and refer to specimen holding institutions: AM — Australian Museum, Sydney; BM — British Museum (Natural History), London; NMV — Museum of Victoria, Melbourne; NTM —

Northern Territory Museum, Darwin; QM — Queensland Museum, Brisbane.

SYSTEMATICS

Order POECILOSCLERIDA Topsent, 1928

Family MYXILLIDAE Topsent, 1928

Genus *Acarnus* Gray, 1867

Acarnus Gray, 1867, p. 544. [type-species; *Acarnus innominatus* Gray by monotypy].

Fonteia Gray, 1867, p. 544. [type-species; *Fonteia anomala* Gray by monotypy. Gray (1867, p. 544) established this genus for a sponge figured by Bowerbank (1864, figs 73-76), and he attributed the specific name to Bowerbank also. No record of that name was found in any of Bowerbank's monographs on British Sponges, and furthermore the figures referred to by Gray (viz. 73-76) are those of *Acarnus innominatus* (which has page priority)].

? *Trefortia* Dezsö, 1880. [according to de Laubenfels (1936, p. 92); neither the genus nor the type-species were gazetted by the Zoological Record].

Acanthacarnus Lévi, 1952, p. 54. [type-species: *Acanthacarnus souriei* Lévi by monotypy. The genus was placed into synonymy with *Acarnus* by Van Soest (1984), on the basis that the acanthostyles of *Acanthacarnus* represent the retention of an ancestral character, which therefore cannot be used as a character to separate genera. Van Soest retains the taxon at the subgeneric level].

DIAGNOSIS

The most recent definition of *Acarnus* (Van Soest 1984, p. 60) is here expanded.

Ectosomal skeleton with a tangential layer of amphitylotes, and with a more-or-less hispid surface produced by styles from ascending fibres and cladotylotes poking through the surface. Choanosomal skeleton with a renieroid reticulation of spongin fibres cored by styles, or with a reduced plumo-reticulate skeleton, or further reduced to a plumose-halichondroid skeleton in encrusting forms. Fibres composed of moderate to very light spongin, and echinated by smooth and/or spined cladotylotes, and sometimes by small acanthostyles. Light spongin with or without auxiliary styles strewn between fibres. Microscleres palmate isochelae and diverse forms of toxas.

REMARKS

The genus *Acarnus* was established by Gray (1867, p. 544) for *Acarnus innominatus*, based on figures of an unidentified sponge of Bowerbank (1864). These figures were also used to erect *Fonteia anomala* Gray (1867, p. 544), which becomes *nomina nuda*.

Originally included with the Tethyadae by Gray (1867) on the basis that cladotylotes were related to tetraxonid spicules, Ridley (1884) placed the genus in the family Ectyonidae, because he considered that the cladotylotes of *Acarnus* resemble acanthostyles of *Clathria* Schmidt and *Echinodictyum* Ridley. Various minor reorganizations occurred in the taxonomic placement of *Acarnus*, such as with the old family Desmacidonidae, subfamily Ectyoninae (e.g. Dendy 1905; Hentschel 1912), but Thiele (1903) adopted Topsent's (1894) system of classification in placing the genus with the family Poeciloscleridae, later to become the order Poecilosclerida.

Several more recent schemes have been proposed for the placement of *Acarnus*.

(1) Dendy (1922) established the section Acarneae for this genus as distinct from his subdivisions Clathreae and Myxilleae, to include species having echinating cladotylotes (which he suggested were merely modified acanthostyles), ectosomal amphitylotes, palmate isochelae and toxas. In his opinion, *Acarnus* did not fit with either the Myxilleae (which have arcuate isochelae), or the Clathreae (which have monactinal ectosomal megascleres). Topsent (1928) raised Dendy's groups to family level, and several other authors have since used that system

(de Laubenfels 1932; Lévi 1952, 1963; Sarà 1960; Ruetzler 1965). Boury-Esnault (1971, 1973) placed *Acarnus* in the Acarnidae also, but attributed the family to de Laubenfels (1936). The family Acarniidae de Laubenfels was erected for Gray's genus *Acarnia*, and several other small or poorly known genera (de Laubenfels 1936, p. 79), and is characterized by the presence of spiny megascleres only, which may be entirely diactinal, or a combination of diactinal and monactinal. Acarniidae de Laubenfels is neither a valid taxon (containing some freshwater Spongillidae together with marine axinellids) nor closely related to Acarnidae Topsent.

(2) Burton (1959) placed *Acarnus* with genera such as *Clathria*, *Plocamilla* Topsent, and *Echinodictyum* in a subfamily Clathriinae. Lévi (1973) and Vacelet *et al.* (1976) follow this system, and include the genus with the Family Clathriidae Hentschel (= Microcionidae Carter) on the basis that the microsclere complement of *Acarnus*, and the acanthostyles of *Acanthacarnus* are similar to those of clathriid genera.

(3) de Laubenfels (1936) included *Acarnus* with the family Tedaniidae Ridley and Dendy, placing emphasis on the presence of ectosomal diactinal megascleres, and he was followed by Tanita (1963), Hechtel (1965), Thomas (1970, 1973) and Hoshino (1981). De Laubenfels (1936) notes also that the Tedaniidae are closely related to the Myxillidae Hentschel, both of which have ectosomal diactinal megascleres, but he retains the families as separate. He suggests that the Tedaniidae have mainly smooth choanosomal megascleres and a higher degree of skeletal and fibre organization than the Myxillidae.

(4) Bakus (1966) and Van Soest (1984) consider that the ectosomal characteristics are of greater systematic importance than the megasclere or microsclere complement at the familial level of classification, and accordingly adopt de Laubenfels (1935) scheme. Both authors place *Acarnus* with the family Myxillidae, which includes the Tedaniidae as a subfamily only (after Topsent 1928). In support of this scheme, Van Soest (1984) notes that apart from the ectosomal characters shown by *Acarnus*, the reticulate skeletal architecture is close to other myxillids such as *Lissodendoryx* Topsent. He suggests further that the presence of acanthostyles does not necessarily confer a close affinity between taxa which possess them, because they are probably an unstable taxonomic character, and moreover they occur (independently) in several other families also. The use of ectosomal characters in sponge

taxonomy is consistent with the current differentiation of a large number of genera, particularly poecilosclerids, and even within the family Microcionidae (e.g. *Clathria*, *Dendrocia* and *Rhaphidophlus*).

AUSTRALIAN SPECIES

Acanus thielei Lévi, 1958 (Figs 1-9, 40-43, Table 1)

Acanus thielei Lévi, 1958, p. 35, text-fig. 33. Thomas, 1970, p. 43-6, text-figs 3a-g, 4.

Acanus ternatus (in part): Thiele, 1903, pp. 960-61, fig. 27. Hentschel, 1912, pp. 372-73.

MATERIAL EXAMINED

NTM Z855, Z876: Channel Island, Middle Arm, Darwin, NT, 12°32.7'S, 130°52.5'E, 12-13 m depth, 20 August 1982, P. Alderslade, SCUBA.

DESCRIPTION (2 specimens)

SHAPE: Semi-vasiform to fan-shaped, 100-130 mm high, 110-200 mm wide (edge-to-edge), 3-20 mm thick. Basal attachment discoid, 45 mm in diameter, 10 mm thick.

COLOUR: Light yellow-brown alive (Munsell 2.5Y 8/4). A similar colour is maintained upon preservation.

SURFACE DETAILS: The external surface (exterior of 'vase') is roughened, with corrugations, ridges and semi-papillate projections, 4-10 mm high, pointed apically, usually bifurcate, occasionally rejoined (reticulated) and forming a more-or-less longitudinal array of raised ridges (appearing net-like). The entire external surface is optically hispid. The apical edge has a serrated appearance. The inner surface (interior of 'vase') is relatively optically smooth, with occasional folding, and bearing numerous oscula, 0.8-4.0 mm in diameter. Overall external appearance of these sponges is relatively thin but cavernous.

ECTOSOME: Microscopically the surface is moderately hispid, with cladotylotes extending beyond the surface (with clads pointing outwards), and with styles from the ascending fibres poking through the surface (mainly on the apices of ridges and corrugations). Occasionally smaller cladotylotes appear on the ectosome, at right angles to the surface, but these are confined mainly to the choanosome.

Lying on or just below the surface are amphitylotes, occurring in bundles or singly, sometimes absent from areas of the ectosome. Ectosomal spongin is moderate to light, slightly

granular and containing numerous microscleres interdispersed with the amphitylotes.

Ectosomal layer varies from 25 to 90 μm in thickness.

CHOANOSOME: Skeletal architecture is clearly reticulate, consisting of ascending plumose multispicular tracts, ending blindly at the surface, and interconnected by a sub-renieroid reticulation of uni- or paucispicular tracts. Occasionally large multispicular tracts run parallel to the surface in some sections. Fibres are lightly invested with spongin, but heavily cored by styles (2-10 spicule widths in major tracts, 1-4 spicule widths in minor tracts). The sub-renieroid reticulation forms ovoid chambers, 80-550 μm in diameter; containing abundant interfibril spongin, and heavily invested with microscleres, smaller cladotylotes and auxiliary (smaller, thinner) styles. The fibres are echinated by cladotylotes in moderate numbers, with their clads projecting into the chambers. The smaller category of cladotylote is more abundant within the choanosome than is the larger variety.

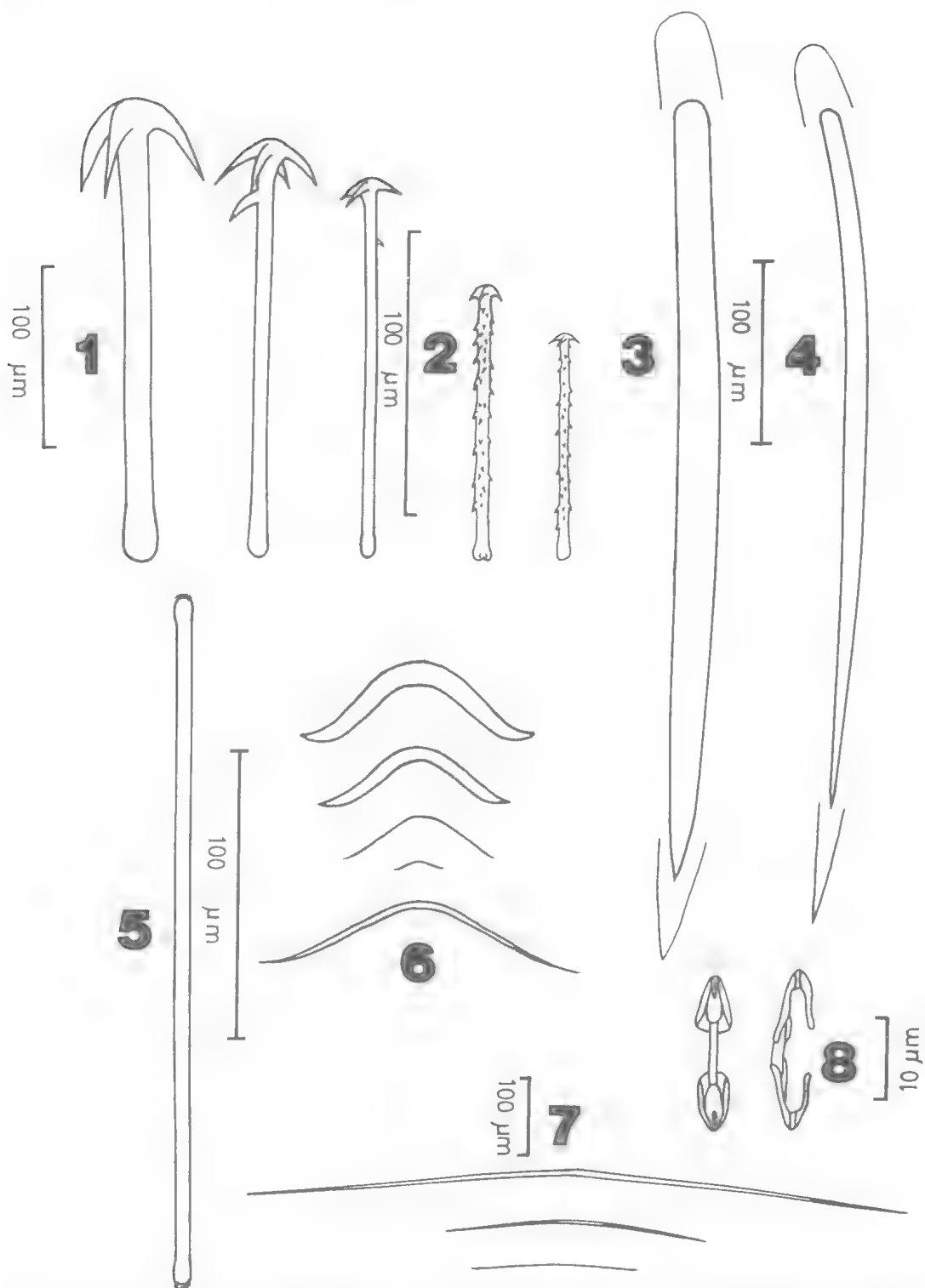
MEGASCLERES: Principal styles — moderately long, thick, hastate, sharply pointed, with rounded bases. Styles are often slightly bent near the base, but sometimes straight. Dimensions ($N=50$): 407.1 μm long (mean) (range 319-464 μm), 21.6 μm wide (14-30 μm).

Auxiliary styles — moderately long, thin hastate to very faintly subtylote, slightly bent near the base, or straight. Dimensions ($N=50$): 321.3 μm long (mean) (range 178-401 μm), 7.5 μm wide (2-11 μm).

Amphitylotes — moderately short, thin, straight, tylote ends rounded, slightly swollen, with microspined tips. Dimensions ($N=50$): 250.1 μm long (mean) (range 194-313 μm), 4.4 μm wide (3-9 μm).

Cladotylotes I — moderately long, thick, straight, mostly smooth shaft, occasionally with few large spines on shaft; tylote base rounded, swollen; 3 clads on apical end. Dimensions ($N=50$): 233.6 μm shaft length (mean) (range 85-270 μm), 9.5 μm shaft width (3-15 μm), 41.7 μm clad chord length (5-70 μm), 47.9 μm wide at clad end (10-70 μm).

Cladotylotes II — small, thin, straight, moderately but consistently spined shaft; tylote bases rounded or obtuse, often bearing small spines (giving the appearance of double ended cladotylotes); 3 clads on apical end, occasionally 4. Dimensions ($N=50$): 86.3 μm shaft length (mean) (range 75-97 μm), 3.4 μm shaft width (2-4 μm), 3.3 μm clad chord length (2-5 μm), 7.4 μm wide at clad end (4-11 μm).



FIGS 1-8: *Acarnus thielei*; 1. smooth cladotylotes (I); 2. spined cladotylotes (II); 3. principal style (inset: enlarged view of extremities); 4. auxiliary choanosomal style (inset: enlarged view of extremities); 5. ectosomal amphitylote; 6. toxas (I); 7. toxas (II); 8. isochelae.

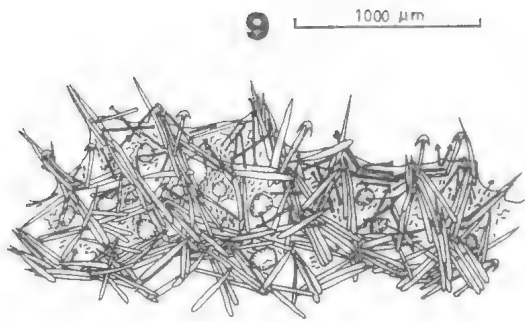


FIG. 9: *Acarnus thielei*, perpendicular section of peripheral skeleton.

MICROSCLERES: *Toxas* I — relatively small and thick, generous central bend, tricurvate with reflexed tips. Dimensions ($N=50$): $76.6\ \mu\text{m}$ chord length (mean) (range $33\text{--}151\ \mu\text{m}$), $4.9\ \mu\text{m}$ wide at centre ($1\text{--}9\ \mu\text{m}$).

Toxas II — small to very large, always thin, slightly bowed to almost straight (oxeote), tips not

reflexed. Dimensions ($N=50$): $341.6\ \mu\text{m}$ chord length (mean) (range $34\text{--}960\ \mu\text{m}$), $2.4\ \mu\text{m}$ wide at centre ($0.5\text{--}7\ \mu\text{m}$).

Isochelae — small palmate. Dimensions ($N=50$): $21.1\ \mu\text{m}$ long (mean) (range $18\text{--}25\ \mu\text{m}$).

ECOLOGY

Both specimens were found on a rock reef which was covered completely by mud and sand, and in an area of high turbidity, with currents of up to 6 knots. There is some morphological variation between the two specimens described here. In particular, Z876 has a strikingly reticulated appearance due to the prominence of regular longitudinal striations on the surface (Fig. 41), whereas Z855 has an irregular raised surface (Fig. 40), and closely resembles *Echinodictyum mesenterinum* (Lamarck) in external appearance. Specimen Z876 has fewer echinating cladotylotes of either variety than does Z855. From the present observations and published records, it appears that *A. thielei* is a shallow-water species, with bathymetric distribution extending from the intertidal zone to 13 metres depth.

TABLE 1. Comparison between published records of *Acarnus thielei*. All measurements are given in micrometres, and denoted as length \times width.

CHARACTER	AUTHOR				
	Lévi (1958) type-specimen	Thomas (1970)	Thiele (1903)	Hentschel (1912)	Present study
Colour alive:	orange	orange	?	light brown	light yellow brown
Shape:	massive, volumous, irregular	digitate on broad base	?	bulky, cylindrical or plate-like	fan-like to semi-vasiform
Skeleton:	renieroid reticulation	sub-renieroid reticulation	?	?	sub-renieroid reticulation
Styles:	$260\text{--}270 \times 6$	$301\text{--}452 \times 13\text{--}24$	350×15	$300\text{--}384 \times ?$	$178\text{--}464 \times 2\text{--}30$
Amphitylotes:	230×1	$207\text{--}283 \times 2\text{--}4$	230×4	$220\text{--}304 \times ?$	$194\text{--}290 \times 3\text{--}9$
Cladotylotes I: (smooth)	150×4	$188\text{--}245 \times 8\text{--}12$	160×2	$160\text{--}272 \times ?$	$85\text{--}270 \times 3\text{--}15$
Cladotylotes II: (spined)	90×2	$75\text{--}96 \times 3\text{--}4$	$90 \times ?$	$95 \times ?$	$75\text{--}97 \times 2\text{--}4$
<i>Toxas</i> I:	$30\text{--}375 \times ?$	$25\text{--}155 \times 8$	$125 \times ?$	$72\text{--}176 \times ?$	$33\text{--}151 \times 1\text{--}9$
<i>Toxas</i> II:		$84\text{--}584 \times 3$		$658\text{--}948 \times ?$	$34\text{--}960 \times 0.5\text{--}7$
<i>Isochelae</i> :	8–9	8–10 (scarse)	20	19–29	18–25
Locality:	Abulat, Red Sea	Palk Bay, Bay of Bengal, Indian Ocean	Ternate, Banda Sea, Indonesia	Aru I., Arafura Sea, Indonesia	Darwin, Australia

DISTRIBUTION

This species is restricted to the Indian Ocean (Indo-Australian) region. Localities are: Darwin, Australia (present study), Aru Island and Ternate, Mollucas, Indonesia (Thiele 1903, Hentschel 1912), Palk Bay, Bay of Bengal, India (Thomas 1970), and Abulat, Red Sea (Lévi 1958).

REMARKS

This species is diagnosed as *A. thielei* in having 2 different forms of cladotylote megascleres, the larger (mostly) smooth, the smaller invariably spined, at least two distinct forms of toxas, in specific details of spicule measurements, and in overall habit.

There are certain details of spicule dimensions found in the present material which differ from published records of *A. thielei* (Table 1). In particular, the Darwin specimens have a smaller category of style, here denoted as the auxiliary styles, which is mainly found outside the fibres. These are probably young forms of the larger, or principal styles, and both forms are combined and considered together in the following Tables. *Acarnus thielei* sensu lato has a broad range of isochelae sizes. Specimens from the western Indian Ocean (Lévi 1958; Thomas 1970) have small isochelae (8–10 μm long), whereas eastern Indian Ocean specimens (Thiele 1903; Hentschel 1912; present study) have larger isochelae (19–29 μm long). It is probable that this difference between the two populations is of little taxonomic significance, and indeed Lévi (1958, p. 36) in synonymizing Thiele's (1903) and Hentschel's (1912) specimens of *A. ternatus* with *A. thielei* considers that cladotylote morphology and size are more important diagnostic characters than the size of isochelae.

Thomas (1970) notes that the smaller cladotylotes of the Indian specimen have smooth bases whereas those of the Darwin specimens are frequently spined, occasionally resembling double-ended cladotylotes.

Acarnus thielei has close affinities with two other species, *A. erithacus* and *A. innominatus* in having both larger smooth and smaller spined varieties of cladotylotes. On that basis Lévi (1963) assigned all 3 species to his group III *Acarnus*. It is difficult to separate these 3 species by their spicule dimensions alone. All show considerable intraspecific variability and consequently overlap in their ranges of spicule measurements (Table 5). Generally, *A. thielei* may be differentiated from the other 2 species by its habit (massive, flabellate, plate-like or digitate, versus encrusting, sometimes

massively encrusting, respectively). *Acarnus erithacus* has predominantly acanthose cladotylotes, which differentiates it from *A. innominatus* (see below) (Van Soest 1984).

***Acarnus innominatus* Gray, 1867**
(Figs 10–18, 44, Table 2)

unidentified sponge, Bowerbank, 1864, pp. 23, 33, 122, 239, pl. 3, figs 73–76, pl. 18, fig. 292.

Acarnus innominatus Gray, 1867, p. 544. Carter, 1871, pp. 269, 273–4. Arndt, 1927, pp. 133–53, pl. 3, fig. 5. de Laubenfels, 1936, pp. 92–93, pl. 12, fig. 2. Lévi, 1963, pp. 48–49, text-fig. 55, pl. 7G. Alcolado, 1976, p. 5. Randall and Hartman, 1968, pp. 218, 219, 223. Van Soest, 1984, pp. 61–3, text-fig. 22, pl. 5, figs 6–9.

? *Fonteia anomala* Gray, 1867, p. 544.

Acarnus carteri Ridley, 1884, pp. 453–4 (footnote).

MATERIAL EXAMINED

NTM Z2234: Dudley Point Reef, East Point Fish Reserve, Darwin, NT, 12°25.0'S, 130°49.1'E, intertidal, 8 March 1985, J.N.A. Hooper.

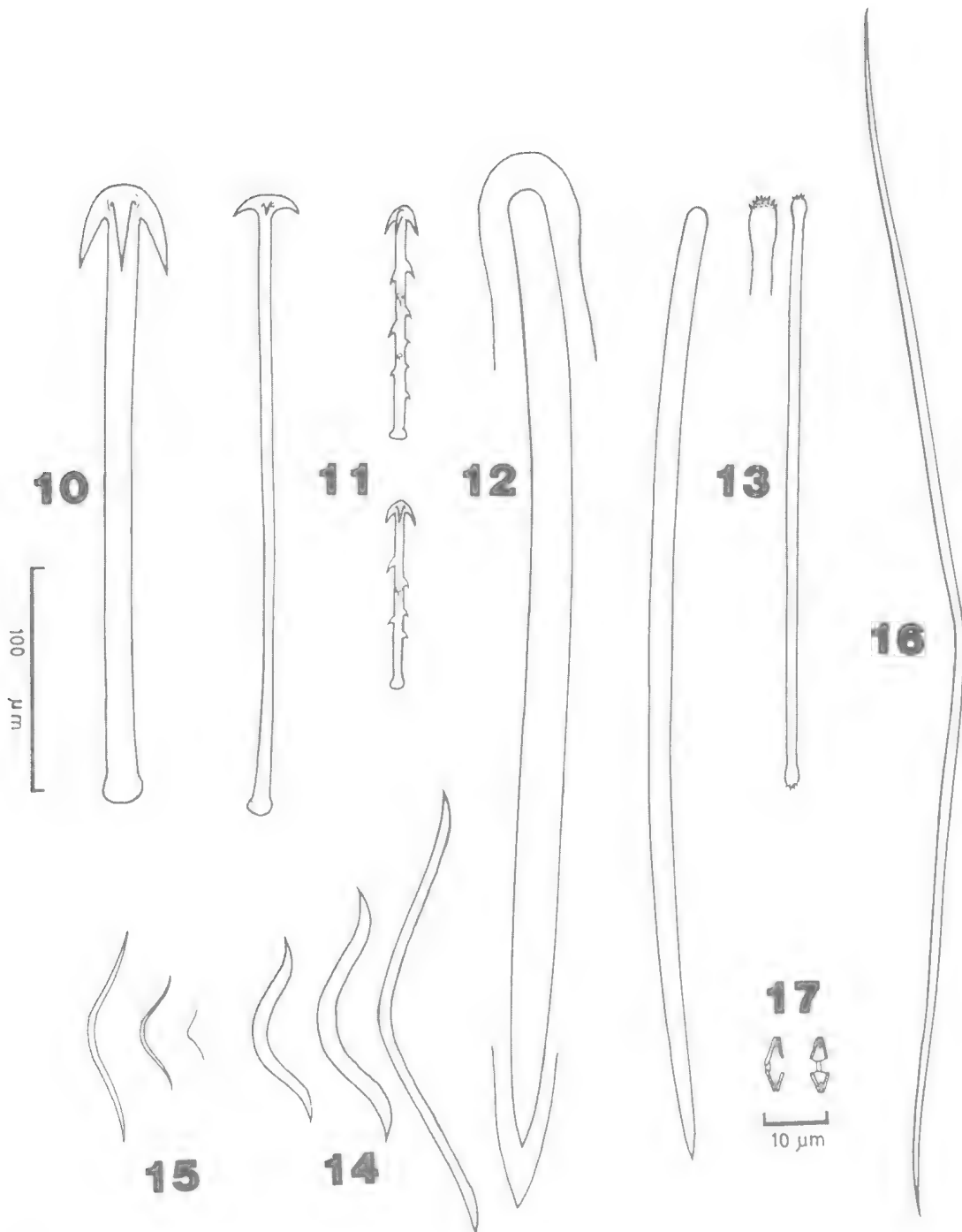
DESCRIPTION

SHAPE: Thickly encrusting, sprawling across dead coral substrate, covering an area of approximately 45 cm^2 .

COLOUR: Bright orange-red alive (Munsell 5R 5/12), yellow-brown in ethanol (5YR 7/10).

SURFACE DETAILS: Surface is of variable thickness, shaggy, with irregular papillose projections up to 3 mm high and 3 mm in diameter, which are optically hispid. Longitudinal grooves meander across the surface, often with a membranous ectosomal covering, approximately 1.6 mm wide and of variable depth. Oscula are abundant, scattered, slightly raised above the surface, 1.1–3.4 mm in diameter, sometimes with a trace of silt around the margins of the lip.

ECTOSOME: Microscopically the surface is microconulose and hispid, with the clad-ends of the large cladotylotes extending beyond the surface. Few principal styles poke through the ectosome. The ectosome has a prominent but often confused tangential layer of amphitylotes lying mainly parallel with the surface, occasionally at right angles to it. Amphitylotes predominantly occur in bundles of up to 5 spicules abreast, sometimes lying singly. Ectosomal spongin is light, yellow-brown, granular and contains numerous microscleres, often arranged in tracts just below the surface. Small particles of detritus (silt, sand grains) are included in parts of the ectosome, but generally the area is clear of inorganic debris. Ectosomal layer varies from 15 to 40 μm in thickness.



FIGS 10–17. *Acarnus innominatus*. 10. smooth cladotylotes (I); 11. spined cladotylotes (II); 12. choanosomal styles (inset: enlarged view of extremities); 13. ecotosomal amphitylote (inset: enlarged view of extremity); 14. thick toxa (I); 15. short, thin toxa (II); 16. long, thin toxa (III); 17. isochelae.

CHOANOSOME: Skeletal architecture consists of a confused renieroid reticulation of spicule tracts or single spicules. No spongin fibres are visible, but it is possible they are extremely light and cannot be differentiated from the abundant type B mesohyl spongin. Tracts containing 1–5 principal styles abreast are bound together by abundant, loose interfibril spongin at their nodes, and surrounded by relatively heavy deposits of type B spongin. Smooth (I) and spined (II) cladotylotes echinate tracts, particularly at the nodes. Choanosomal renieroid reticulation becomes semi-plumose in the subectosomal region, with single spicule tracts ascending to the surface, ending blindly in microconules, and producing radiating tufts of cladotylotes protruding through the ectosome. Choanosomal spongin is mainly clear of detritus, and meandering tracts of granular spongin, collagenous spongin and microscleres form chambers and canals of variable size (range 70–150 μm in diameter).

MEGASCLERES: Principal styles — moderately long, thick, mostly hastate, occasionally slightly fusiform or even subtylote, usually slightly curved near the basal end, sometimes straight; bases smooth. Dimensions (N=25): 391.5 μm long (mean) (range 267–453 μm), 16.8 μm wide (6–21 μm).

Amphitylotes — moderately short, thin, straight, tylote ends swollen, with microspined tips. Dimensions (N=25): 265.5 μm long (mean) (range 247–283 μm), 3.7 μm wide (3–4 μm).

Cladotylotes I — moderately long, thick, straight shaft, always smooth; tylote ends with rounded or slightly asymmetrical bases; 3–4 clads on apical end. Dimensions (N=25): 258.9 μm shaft length (mean) (range 222–283 μm), 11.0 μm shaft width (6–14 μm), 41.0 μm clad chord length (18–49 μm), 38.3 μm wide at clad end (19–46 μm).

Cladotylotes II — small, thin, straight, with lightly spined shafts and large spines; rounded or asymmetrical bases; 4 clads on apical end. Not common; rare or absent in areas of very thin encrustation. Dimensions (N=25): 99.6 μm shaft length (mean) (range 72–141 μm), 3.9 μm shaft width (3–5 μm), 13.7 μm clad chord length (9–22 μm), 14.3 μm wide at clad end (11–18 μm).

MICROSCLERES: **Toxas I** — relatively small, thick, generously rounded at centre, sometimes almost straight, with reflexed tips. Moderately common. Dimensions (N=25): 90.6 μm chord length (mean) (range 45–249 μm), 3.2 μm wide at centre (2–5 μm).

Toxas II — small, thin, of similar morphology as previous category; possibly a developmental

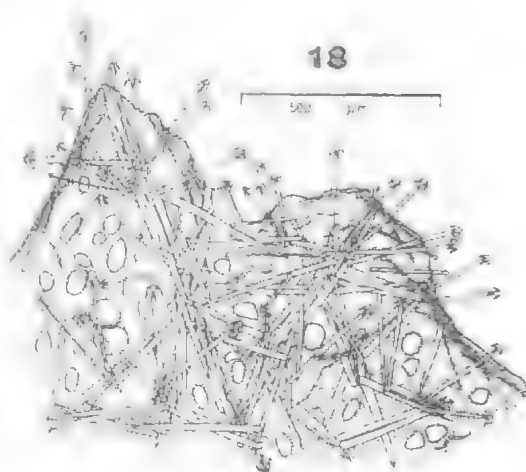


FIG. 18: *Acarnus innominatus*, transverse section of peripheral skeleton.

stage of that category. Very common. Dimensions (N=25): 39.7 μm chord length (mean) (range 21–79 μm), 1.3 μm wide at centre (1–2 μm).

Toxas III — long, moderately thick, mostly straight with small-angled central curvature, and with reflexed tips. Moderately common. Dimensions (N=25): 430.3 μm chord length (mean) (range 192–586 μm), 2.2 μm wide at centre (1.5–3 μm).

Isochelae — very small, palmate. Abundant. Dimensions (N=25): 8.6 μm long (mean) (range 6–10 μm).

ECOLOGY

Found on the undersurface of a dead coral boulder, on an intertidal coral platform, close to the shoreline, and in an area of high sedimentation (mud, silt). Associated with (growing next to) sponges (*Rhaphidophylus* and *Haliclona* spp.), an encrusting coralline algae, and colonial ascidians (possibly *Pycnoclavella*). Previous records of *A. innominatus* suggest that the species is probably restricted to dead corals, with a bathymetric distribution extending from the intertidal zone to 29 metres depth (de Laubenfels 1936; Lévi 1963; Van Soest 1984).

DISTRIBUTION

The present record considerably extends the known distribution of *A. innominatus*. Further studies may show that the species is cosmopolitan, but current records indicate a patchy distribution: Gulf of Mexico and Caribbean Sea (Curaçao,

TABLE 2. Comparison between published records of *Acarnus innominatus*. All measurements are given in micrometres, and denoted as length \times width.

CHARACTER	AUTHOR					
	Carter (1871)	Ridley (1884)	deLaubenfels (1936)	Lévi (1963)	Van Soest (1984)	Present study
Colour alive:	?	?	bright orange to red	scarlet and reddish	red	bright orange-red
Shape:	encrusting, flat, spiculous	?	massive, amorphous, encrusting	massive encrusting	thinly to massively encrusting	thickly encrusting
Skeleton:	polyhedral (renieroid)	?	ascending plumose, rarely anastomosing	anastomosing paucispicular fibres	renieroid reticulation, plumose tracts	confused renieroid reticulation and semi-plumose tracts
Styles:	340.3 \times ?	present	280–300 \times 12–13	175–340 \times 6–20	340–459 \times 11–22	267–453 \times 6–21
Amphitylotes:	?	280 \times 4.5	180 \times 2	130–230 \times 3–4	217–262 \times 2.5–4	247–283 \times 3–4
Cladotylotes I: (smooth)	244.9 \times ?	present	200 \times 6	180–230 \times 8	217–294 \times 7–12	222–283 \times 6–14
Cladotylotes II: (spined)	95.3 \times ?	absent?	80 \times 2	85–90 \times 2	110–115 \times 3 not common	72–141 \times 3–5 not common
Toxas I:				70–80 \times 3–5	57–158 \times 2–4	45–249 \times 2–5
Toxas II:	81.7 \times ?	130 \times 4.2	40–400 \times 1–3		38–68 \times ?	21–79 \times 1–2
Toxas III:				present	200–402 \times ?	192–586 \times 1.5–3
Isochetae:	13.6	16–24	12–15	11	9–18	6–10
Locality:	West Indies	West Indies	Tortugas, Florida	South Africa	Curaçao	Darwin

Cuba, Florida, West Indies) (Gray 1867; Carter 1871; Ridley 1884; Arndt 1927; de Laubenfels 1936; Alcolado 1976; Randall and Hartman 1968; Van Soest 1984), South Atlantic-Indian Oceans (Cape Town and Mossel Bay, South Africa) (Lévi 1963), and Arafura Sea, Indo-Pacific (Darwin, Northern Territory).

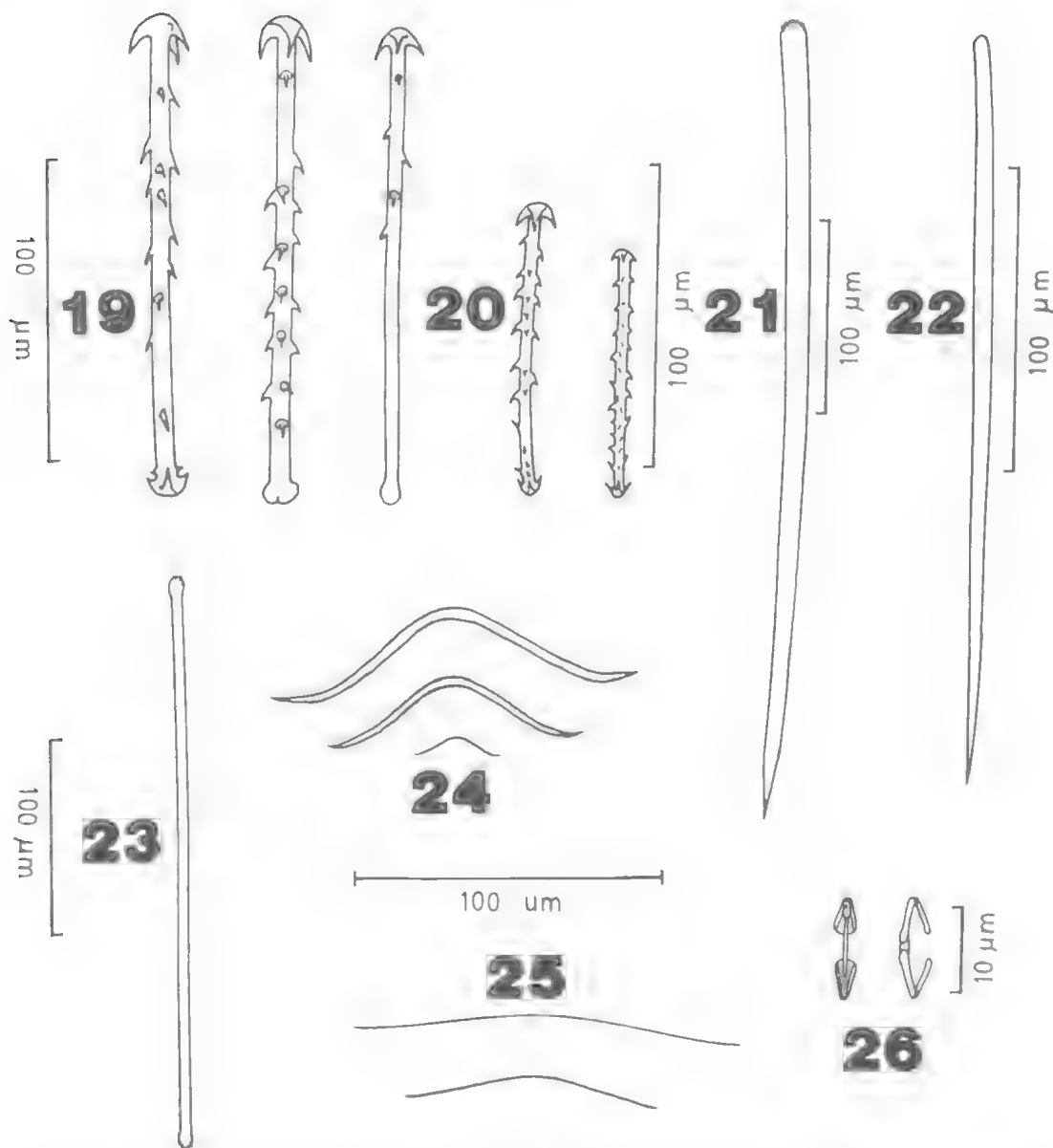
REMARKS

This specimen is easily placed in Lévi's group III *Acarnus* in having both smooth and spined cladotylotes, and on the basis of published descriptions the specimen is diagnosed as *A. innominatus* (refer to Table 2). The species is closest to *A. erithacus*, which has predominately acanthose cladotylotes, but which are rare in *A. innominatus* (Van Soest 1984). Records of *A. erithacus* show a large size range for all spicule categories, and on that basis alone the two species cannot be separated reliably. Details such as the

proportion of smooth and spined cladotylotes, and the form of the longer variety of toxa offer a tentative basis for differentiating these closely related species. Similarly, *A. innominatus* is difficult to distinguish from *A. thielei* on the sole basis of spicule size, and a tentative character used for the separation of those two species is growth form (see above). On that basis I have little hesitation in separating the Darwin specimens of *A. innominatus* and *A. thielei*, which have quite distinct gross morphologies. However, a study on the ecophenotypic variability of all three species (*A. innominatus*, *A. erithacus*, and *A. thielei*) may show them to be conspecific.

Acarnus tortilis Topsent, 1892 (Figs 19–27, 45, Table 3)

Acarnus tortilis Topsent, 1892, pp. 24–5. Topsent, 1897, p. 450. Topsent, 1904, p. 171, pl. 14, fig. 8. Dendy,



Figs 19-26: *Acarnus tortilis*. 19. spined cladotylotes (I); 20. spined cladotylotes (II); 21. principal choanosomal styles; 22. auxiliary choanosomal styles; 23. ectosomal amphitylote; 24. toxas (I); 25. toxas (II); 26. isochelae.

1916, pp. 130-31. Topsent, 1925, pp. 661-2. Topsent, 1929, pp. 19-20, text-figs 1-2. Topsent, 1934, p. 72. Topsent and Olivier, 1943, p. 2. Sarà, 1960, p. 461. Ruetzler, 1965, p. 32. Boury-Esnault, 1971, p. 323. Vacelet *et al.*, 1976, pp. 74-5, text-fig. 50. Desqueyroux-Faundez, 1981, p. 758, Table 2.

MATERIAL EXAMINED

QM GL706 (fragment NTM Z1538): Outer Barrier, East of Lizard Island, Northeast Queensland, 14°42.0'S,

145°45.0'E, 10 m depth, September 1979, Queensland Fisheries Service, trawl.

DESCRIPTION

SHAPE: Flat, thick, sprawling, plate-like encrustation; fragmented; rounded smooth margins, 43 × 75 mm, approximately 4 mm thick.

COLOUR: Grey-brown in ethanol (Munsell 7.5YR 6/2).

SURFACE DETAILS: Surface is rough, where intact, and mostly obscured by detritus incorporated into sponge. The texture is easily crumbled in the preserved state.

ECTOSOME: Microscopically the surface is rough, slightly hispid due to the presence of large cladotylotes projecting outwards, and mainly encrusted with detritus. Amphitylotes are found in loose bundles lying parallel to the surface, lying on or just below the ectosome and in no apparent order, occurring haphazardly throughout the choanosome also. Ectosomal spongin is light brown, non-fibrous, granular, and mostly encrusted with debris.

CHOANOSOME: Skeletal architecture is loosely reticulate, verging on halichondroid due to the reduced, encrusting habit of the sponge. The distinctive feature of the choanosome is the presence of large quantities of detritus incorporated into the skeleton. The size of inorganic particles varies considerably, and particles are bonded together by light spongin. Where visible, spongin fibres are light, forming a loose reticulation containing ovoid chambers, 100–180 μm in diameter. Spongin fibres are 50–80 μm thick, clearly lamellated, yellow-beige in colour, and cored with principal styles in paucispicular tracts, lying 1–4 spicules abreast. Spongin between the fibres is light, slightly granular, abundant in places, and contains microscleres and smaller (auxiliary) styles. Isochelae are found scattered throughout the choanosome, in association with interfibril spongin, but occur in extremely heavy concentrations in places, particularly lying just below the ectosome. Spongin fibres are echinated by cladotylotes of both varieties. Cladotylotes are seen in interfibril spongin, and adhering to the surface of detrital particles also.

MEGASCLERES: Principal styles — moderately long and thin, mostly straight or very slightly curved near the apical end, hastate, sharply pointed, with evenly rounded bases. Bases are smooth or have numerous microspines on basal extremities. Dimensions ($N=25$): 293.8 μm long (mean) (range 214–334 μm), 11.4 μm wide (9–16 μm).

Auxiliary styles — moderately long, thin, hastate, sharply pointed, with evenly rounded smooth bases. Dimensions ($N=25$): 248.6 μm long (mean) (range 215–279 μm), 5.2 μm wide (3–7 μm).

Amphitylotes — long, thin straight, slightly swollen tylote ends, with numerous microspines covering extremities, or occasionally smooth. Dimensions ($N=25$): 288.4 μm long (mean) (range 222–363 μm), 5.3 μm wide (4–7 μm).

Cladotylotes I — moderately small, thin with straight shafts. Shaft is invariably echinated by moderately large spines (3–10 μm in length). Clads occur on one or both ends. Principal clads are variable in size and 4 in number. The basal end has small clads (1–4 μm long if present), or has a rounded bulbous smooth tylote base. Dimensions ($N=25$): 175.9 μm shaft length (mean) (range 151–212 μm), 6.2 μm shaft width (4–8 μm), 16.0 μm clad chord length (12–22 μm), 18.2 μm wide at clad end (12–22 μm).

Cladotylotes II — straight, short, thin, mostly heavily echinated with small spines along the shaft. Spines 1–3 μm long. Clads occur on 1 or both ends, and are similar in morphology to those of the larger variety. Main clads are variable in length, and 4 in number. Dimensions ($N=25$): 80.7 μm shaft length (mean) (range 58–109 μm), 3.8 μm shaft width (3–5 μm), 8.2 μm clad chord length (4–12 μm), 11.2 μm wide at clad end (8–17 μm).

MICROSCLERES: Toxas I — relatively thick, generously curved, tricurvate, with reflexed tips; moderately uncommon. Dimensions ($N=25$): 68.4 μm chord length (mean) (range 44–110 μm), 2.4 μm wide at centre (1–4 μm).

Toxas II — thin, long, almost oxeote or only slightly curved, with a slight central bend; tips not reflexed. Very rare. Dimensions ($N=5$): 162.5 μm

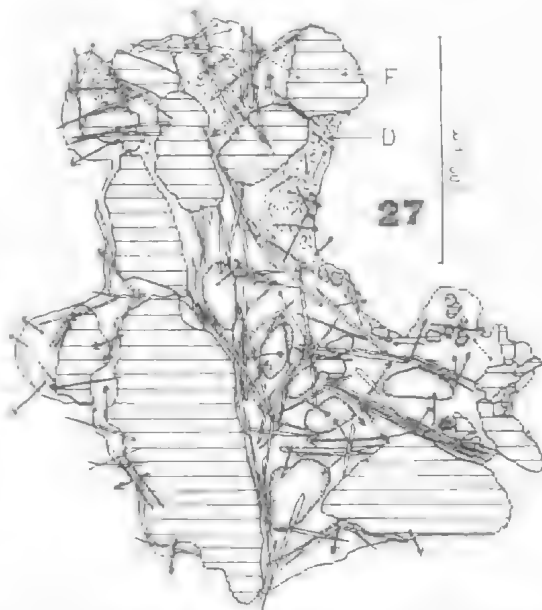


FIG. 27. *Acarus fortis*; perpendicular section through choanosome. D: Deposits of heavy loose spongin, cored by microscleres; F: foreign particles incorporated into skeleton.

chord length (mean) (range 150–265 μm), 1.5 μm wide at centre (1–2 μm).

Isochelae — small, palmate, very abundant. Dimensions (N = 25): 11.1 μm long (mean) (range 7–13 μm).

ECOLOGY

This specimen was apparently associated with a dead coral and sand substrate. From published records and present observations, the bathymetric distribution of *A. tortilis* extends from the intertidal zone to 54 metres depth.

DISTRIBUTION

Acarnus tortilis is a widely distributed, almost cosmopolitan species, recorded from the North Atlantic and Indian Oceans (Topsent 1904, 1929; Vacelet *et al.* 1976), Mediterranean, Adriatic, Arabian, Banda, Biban and Oman Seas (Boury-Esnault 1971; Dendy 1916; Ruetzler 1965; Sarà 1960; Topsent 1892, 1897, 1925, 1929, 1934; Topsent and Olivier 1943). The specimen described

above is the first record for the species in the Pacific Ocean.

REMARKS

This species is easily diagnosed as *A. tortilis* in having two varieties of cladotylotes, both of which have profusely spined shafts, an encrusting habit incorporating foreign particles into the skeleton, and in specific details of spicule dimensions (Table 3).

Lévi (1963) placed *A. tortilis* in his group II *Acarnus* on the basis of having spined cladotylotes only. *Acarnus tortilis* is closest to *A. topsenti* in this respect, and differs from that species mainly by its habit (encrusting versus flabellate-digitate, respectively), in having two categories of cladotylotes, and by the specific dimensions of spicules (Table 4). The stability of those diagnostic characters is presently unknown, particularly with regard to known intraspecific geographic variation in spicule dimensions, with some spicule categories overlapping between the species (Table 5).

TABLE 3. Comparison between published records of *Acarnus tortilis*. All measurements are given in micrometres, and denoted as length \times width.

CHARACTER	AUTHOR				
	Topsent (1892) type-specimen	Topsent (1904)	Topsent (1925)	Vacelet <i>et al.</i> (1976)	Present Study
Colour alive:	brown	blackish	reddish	red	(grey-brown in ethanaol)
Shape:	thinly encrusting	encrusting	encrusting	encrusting	encrusting
Skeleton:	loosely reticulate	?	?	?	loosely reticulate to halichondroid
Styles:	500 \times 10	400–450 \times 8–10	515–550 \times ?	300–450 \times 5–10	214–334 \times 3–16
Amphitylotes:	400 \times ?	370–440 \times 4–5	307–360 \times ?	250–350 \times 3.5–6	222–363 \times 4–7
Cladotylotes I: (spined)	up to 220 \times 5	125–170 \times 4–5	75–160 \times ?	65–225 \times 2.5–5	151–212 \times 4–8
Cladotylotes II: (spined)					58–109 \times 3–5
Toxas I:	present	100 \times 4	130 \times ?	60–80 \times 4–5	44–110 \times 1–4
Toxas II:	present	220 \times 1	210 \times ?	15–160 \times ?	150–265 \times 1–2
Isochelae:	15	15	22	8–10	7–13
Locality:	Cape Abeille, Gulf of Lyon Mediterranean	Terceira I., Azores, North Atlantic	Nisida, Gulf of Naples, Mediterranean	Tuléar, Mozambique Channel, Indian Ocean	East of Lizard I., GBR, NE Queensland

Another character which differentiates these allied species is the degree of development of the fibrous skeleton. *Acarnus topsenti* has strongly developed horny fibres, whereas those of *A. tortilis* are reduced and are invested with light spongin only. The taxonomic value and stability of that character remains to be determined, as it is possible that the reduction of horny fibres in *A. tortilis* is related to its reduction in growth form.

As an indication of their close affinities, and supporting a possible combination of the two species, is the fact that the bases of the principal styles in both species frequently have a light covering of microspines. This character is consistent throughout the entire geographic range of *A. tortilis* (Topsent 1892, 1897, 1904, 1925; Dendy 1916; Vacelet *et al.* 1976; present study), and Dendy (1922) records it for *A. topsenti* also. No other species of *Acarnus* (*Acarnus*) have this characteristic, although it is present in *Acarnus* (*Acanthacarnus*) species. It is clear that the relationship between *A. tortilis* and *A. topsenti* is closely analogous to that of *A. thielei* and *A. innominatus*, as discussed above. Unfortunately the type-specimen of *A. tortilis* is presently unavailable for re-examination, requiring a visit to the Paris Museum (Lévi pers. comm.). Consequently it is not possible to make a firm decision on whether or not the two species are conspecific. Vacelet *et al.* (1976) recommended that the two species should be maintained as separate, and his decision is supported here on a tentative basis through comparison between the Queensland specimen of *A. tortilis* and the syntype of *A. topsenti* (see below).

De Laubenfels (1927) and Bakus (1966) suggest that *A. erithacus* is closely related to *A. tortilis* in skeletal architecture, but this affinity may be a result of a reduced skeletal architecture of both species, owing to their encrusting habits. *Acarnus erithacus* is easily differentiated from *A. tortilis* by the presence of a larger category of smooth cladotylote megasclere, and in having a heavier fibrous skeleton.

Acarnus toxatus should be included in Lévi's (1963) group 11 *Acarnus* also, in having spined cladotylotes only, but differs from *A. tortilis* in having larger spicules of most categories (except isochelae), and three distinct categories of toxas (Table 5).

***Acarnus ternatus* Ridley, 1884**
(Figs 28–36, 46–48, Table 4)

Acarnus ternatus Ridley, 1884, pp. 453, 615, pl. 42, figs 3, b'. Ridley and Dendy, 1887, p. 159. Dendy, 1905,

p. 177, pl. 8, fig. 4, Lévi, 1958, p. 35, (text-fig. 32, Bruce, 1976, p. 128.

non *Acarnus ternatus*: Thiele, 1903, pp. 960–61, fig. 27. Hentschel, 1912, pp. 372–3.

Acarnus wolffgangi Keller, 1889, pp. 399–400, pl. 24, figs 53–58. Kieschnick, 1896, p. 533. Thiele, 1903, pp. 960–61, fig. 26.

MATERIAL EXAMINED

SYNTYPE: BM 1882.2.23.248: West Island, Torres Strait, North Queensland, 10°22'S, 142°04'E, 14 m depth, ? April–October, 1881. H.M.S. 'Alert', dredge.

OTHER MATERIAL: QM GL2773 (fragment NTM Z1584), QM GL2777 (fragment NTM Z1590): 20 kilometres northeast of Green Island, off Cairns, Great Barrier Reef, northeast Queensland, 16°43.0'S, 146°03.0'E, 80 m depth, 21 February 1979, L. Cannon and B. Goeden (sta. W5 Cairns preliminary inter-reef survey), dredge. QM GL715 (fragment NTM Z1532): Hall-Thompson Reef, East of Innisfail, Great Barrier Reef, Northeast Queensland, 17°34.0'S, 146°27.5'E, 66 m depth, date of collection unknown, Queensland Fisheries Service, dredge or trawl.

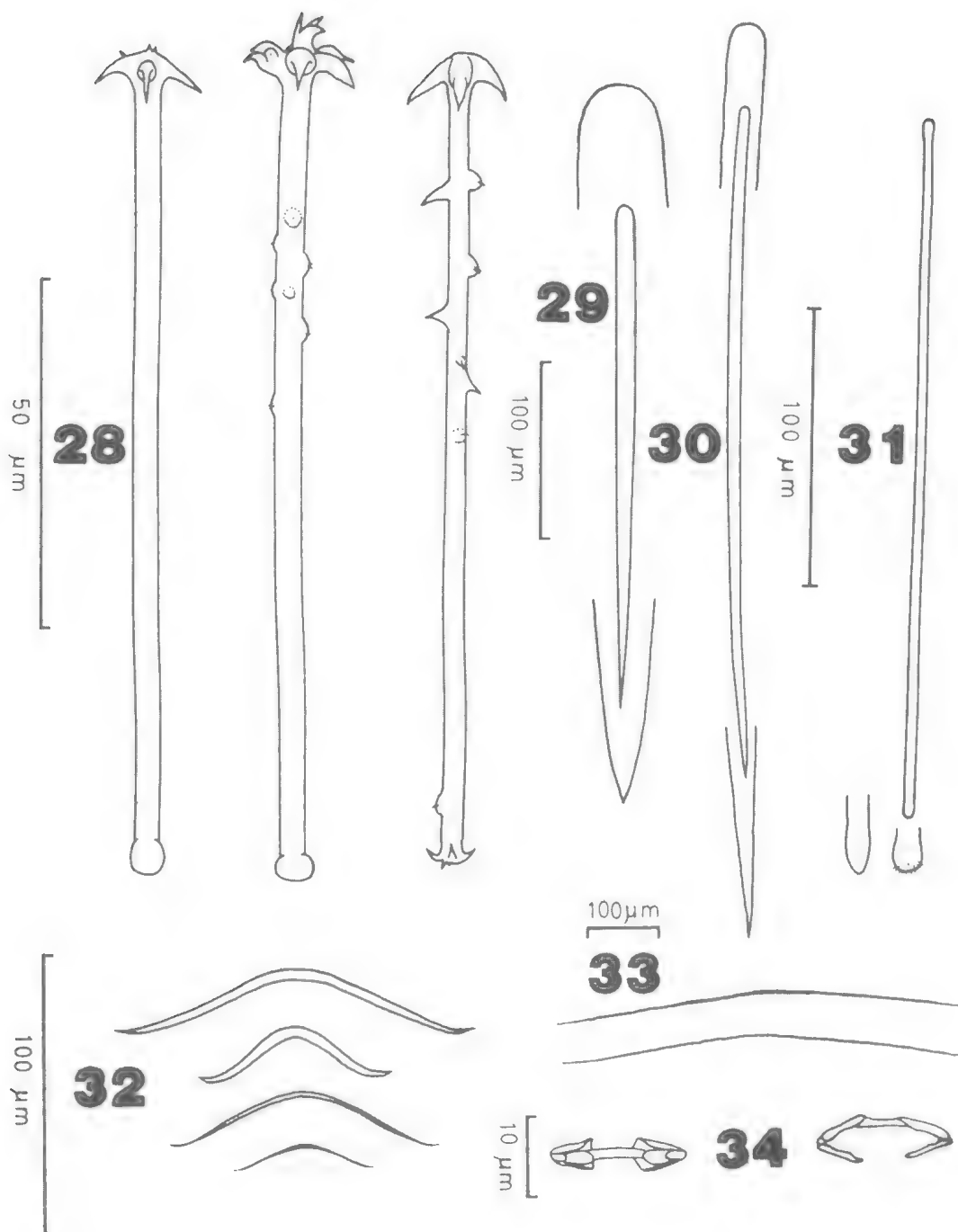
REDESCRIPTION OF TYPE-SPECIMEN

DETAILS OF EXTERNAL MORPHOLOGY: refer to Ridley (1884, p. 453).

ECTOSOME: The ectosomal region has a multispicular, sometimes confused, but mostly tangential layer of amphitylotes lying on or just below the surface. The surface is raised into conules in places, and is lightly hispid from the tips of cladotylotes and occasionally styles poking through the ectosome.

CHOANOSOME: The skeletal architecture is a heavy renieroid to sub-renieroid reticulation of thick fibres (35–120 µm in diameter), cored by uni- to multi-spicular tracts which do not occupy the entire diameter of fibres. Major tracts appear to run longitudinally, cored by 5–10 spicules abreast, and are interconnected by smaller ascending tracts, containing 1–5 spicules abreast. There is only slight plumose divergence of fibres in the subectosomal region, and fibres are predominantly anastomosing. Chambers formed by the fibre reticulation are subrectangular to ovoid, 112–435 µm in diameter. Cladotylotes are not abundant, variable in size, and echinate fibres at right angles to spicule tracts. The mesohyl matrix has heavy deposits of debris scattered between the fibres, but there are also many large cavernous chambers formed by fibre anastomoses clear of debris and spicules. Loose, granular spongin between the fibres is mostly paucispicular.

MEGASCLERES (N=25): Principal styles — robust, hastate, slightly curved at the centre, entirely smooth shafted, and with evenly rounded bases having little or no tylote swelling; tips taper



FIGS 28-34: *Acarnus ternatus*. 28. smooth and occasionally-spined cladotylotes (I); 29. principal choanosomal style (inset: enlarged view of extremities); 30. auxiliary choanosomal style (inset: enlarged view of extremities); 31. ectosomal amphitylote (inset: enlarged view of spined and smooth ends); 32. toxas (I); 33. toxas (II); 34. isochelae.

to sharp points, or are sometimes blunt or rounded. 325.8 μm long (mean) (range 265–419 μm), 11.8 μm wide (7–14 μm).

Auxiliary styles — not abundant; of thinner and shorter dimensions than the previous category, and probably young forms of those spicules. 201.4 μm long (mean) (range 128–285 μm), 2.4 μm wide (2–4 μm).

Amphitylotes — thin, moderately long, straight, with only slightly tylote bases, and with very few or no microspines on apices. 248.4 μm long (mean) (range 224–268 μm), 3.5 μm wide (3–4.5 μm).

Cladotylotes — variable in size, and not abundant; straight or slightly curved shaft, mostly smooth, but some spicules have occasional, isolated spines on the shaft; bases are prominently tylote, mostly smooth and evenly rounded, or sometimes with apical spines or tuberculate; 3 clads on apical end, which are of variable length; the apex of the clad end is mostly smooth and evenly rounded. 182.2 μm shaft length (mean) (range 63–233 μm), 7.0 μm shaft width (2–11 μm), 21.8 μm clad chord length (2–34 μm), 23.7 μm wide at clad end (5–36 μm).

MICROSCLERES (N=25): *Toxas* I — short to moderately long, variable in thickness, mostly generously curved at the centre, and reflexed at the tips. 112.9 μm long (mean) (range 12–233 μm), 3.5 μm wide (0.8–6 μm).

Toxas II — short to very long, moderately thin, only slightly curved at the centre, and only slightly reflexed, sometimes oxeote. 262.2 μm long (mean) (range 19–708 μm), 2.0 μm wide (0.5–5 μm).

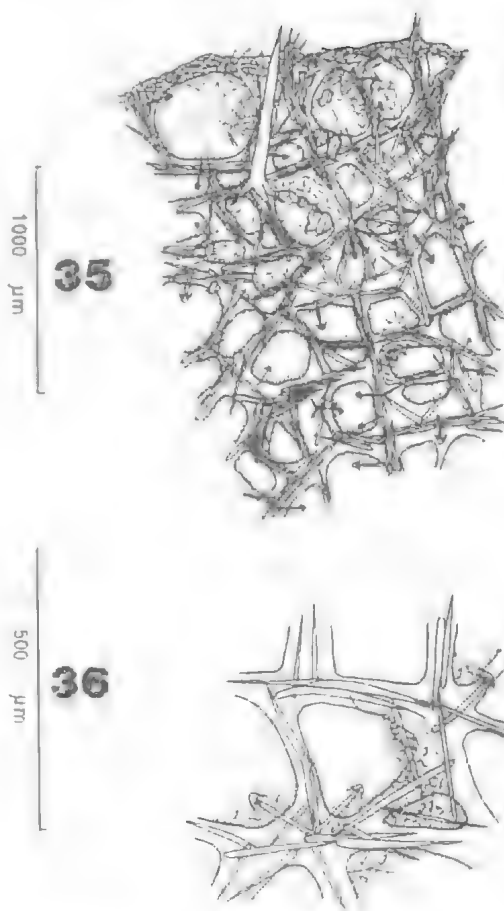
Isochelae — palmate, variable in size. 16.4 μm long (mean) (range 8–22 μm).

DESCRIPTION OF OTHER SPECIMENS

SHAPE: plate-like, thickly flabellate, probably semi-vasiform, fragmented, basal attachment not collected. 50–110 mm wide edge-to-edge, 55–83 mm high, 3.5–5 mm thick. One smaller atypical specimen (QM GL715) has solid tubulo-digitate projections arising from a semi-encrusting, bulbous base, and is growing on a bivalve shell and pebbles. Base 35 mm wide, 54 mm high at highest point; digits short, twisted, 10–18 mm high, 4–13 mm in diameter.

COLOUR: light brown (Munsell 2.5Y 8/4) to brown-grey in ethanol (10R 6/2).

SURFACE DETAILS: External surface of sponge (exterior of 'vase' or 'plate') is roughened, with numerous surface projections, which are mostly low and rounded, extending not more than 20 mm from the sponge surface, and forming irregular



FIGS 35–36: *Acarnus ternatus*. 35, perpendicular section of peripheral skeleton; 36, enlarged view of choanosomal fibres.

meandering tracts. The internal surface (interior of 'vase' or 'plate') is optically smooth, and contains many oscula of 1–6 mm in diameter. The entire surface is optically hispid, and the overall flabellate/vasiform habit resembles closely that of *Acarnus thielei* from Darwin. The smaller specimen has a dusty appearance due to sand debris embedded in the ectosome.

ECTOSOME: The ectosome is mostly even microscopically, with few conules formed by fibre endings from the choanosomal skeleton poking through the surface, and with the tips of styles rendering the surface hispid. Few cladotylotes were observed poking through the ectosome. The ectosome has a thin tangential layer of amphitylotes lying on or just below the surface. The ectosome also has a thin layer of detritus

TABLE 4. Comparison between published records of *Acarnus ternatus*. All measurements are given in micrometres, and denoted as length \times width.

CHARACTER	AUTHOR					
	Ridley (1884)* type-specimen	Keller (1889)	Thiele (1903)	Dendy (1905)	Lévi (1958)	Present Study
Colour alive:	reddish-brown (preserved)	matt blue	?	brown (dry)	red	light brown- grey brown (preserved)
Shape:	clathrous, rounded, anastomosing tubes	massive, rounded rough exterior surface	?	thickly flabellate, lobed margins, to irregularly branched	massive irregular, folded surface	flabellate- vasiform to tubulo-digitate semi- encrusting rough surface
Skeleton:	heavy renieroid to sub- renieroid reticulation	reticulate, strongly developed fibres	?	strongly developed fibres	reticulate	renieroid to sub-renieroid reticulation
Styles:	128–419 \times 2–14	305–320 \times 15	450 \times 25	300 \times 16.4	275–310 \times 6	139–281 \times 2–14
Amphitylotes:	224–268 \times 3–4.5	approx. 220 \times ?	260 \times 4	220 \times 3.5	240 \times 1.5	200–280 \times 2–5
Cladotylotes I: (smooth)	63–233 \times 2–11	200–220 \times 10	275 \times 12	210 \times 12	180–200 \times 5	85–205 \times 2–6
Toxas I:	12–233 \times 0.8–6	up to 600 \times 3	60–250 \times ?	up to 152 \times 8	35–130 \times 1–3	41–266 \times 1–6
Toxas II:	19–708 \times 0.5–5		900 \times ?	740 \times 4	375–600 \times ?	80–770 \times 0.5–5
Isochelae:	8–22	15	22	20	18	9–22
Locality:	Torres Strait, Australia. (Also ?Bombay, India, and Amirante Is.)	Sudan, Red Sea	Ternate, Banda Sea, Indonesia	Gulf of Manaar, Indian Ocean	Abulat, Red Sea	Great Barrier Reef, Queensland

*Morphology cited by Ridley (1884, p. 453) as close to *A. innominatus*.

Values given here are from the redescription of the syntype B.M. 1882.2.23.248.

overlying the skeleton, consisting of non-contort spined spiraster-like spicules, large quantities of sand and shell debris.

CHOANOSOME: The overall skeletal architecture is a renieroid to sub-renieroid reticulation of relatively heavy, pale yellow spongin fibres, 20–130 μm in diameter, moderately cored by bi- or multispicular tracts of principal styles. Major spicule tracts run longitudinally through sections, are cored with 3–8 spicules abreast, and are connected by vertical, ascending spicule-spongin tracts, with 1–3 spicules abreast. The reticulation in deeper parts of the choanosome is regular, renieroid, whereas closer to the surface the

ascending (secondary) spicule tracts become plumose. The fibre reticulation forms ovoid to subrectangular chambers, 120–450 μm in diameter. Fibres are echinated by cladotylotes of 1 variety only, which vary in abundance between specimens (few in larger specimens, common in the smaller specimen). Spongin between the fibres is scarce, and where present, is cored with auxiliary styles and microcleres. Amphitylotes also occur in loose bundles in the choanosome, lying mainly at right angles to the surface. Moderate quantities of detritus, mostly sand grains occur in the choanosome also, particularly in the smaller specimen.

MEGASCLERES: Principal styles — moderately stout, straight or slightly curved at midsection, hastate, tapering to a sharp point; smooth rounded base with very little or no tylote swelling. Dimensions (N = 75): 248.2 μm long (mean) (range 203–281 μm), 10.3 μm wide (mean) (7–14 μm).

Auxiliary styles — abundant, relatively short, thin, hastate, tapering to a sharp point, smooth rounded base, some slightly subtylote. Dimensions (N = 75): 218.1 μm long (mean) (range 139–252 μm), 4.9 μm wide (2–7 μm).

Amphitylotes — moderately long, thin, straight, evenly rounded (only slightly swollen) tylote ends; few microspines on apical ends, occasionally smooth. Dimensions (N = 75): 235.2 μm long (mean) (range 200–280 μm), 3.6 μm wide (2–5 μm).

Cladotylotes I — relatively short, thin, straight, mostly with smooth shafts, some with occasional (isolated) spines along stem (1–4 μm long); 3 clads, occasionally 4 on the apex; clads recurved or only slightly curved, variable in length, and sometimes bearing 1 or more spines on apex. Bases tylote, smooth, sometimes tuberculate or with small clads. Dimensions (N = 100): 133.3 μm shaft length (mean) (range 85–205 μm), 4.5 μm shaft width (2–6 μm), 12.1 μm clad chord length (4–22 μm), 15.4 μm wide at clad end (5–23 μm).

MICROSCLERES: Toxas I — short, relatively thick, tricurvate, generously curved at midsection and with reflexed tips. Dimensions (N = 75): 79.3 μm chord length (mean) (range 41–266 μm), 2.9 μm wide at centre (1–6 μm).

Toxas II — long, thin, only slightly curved at midsection, some entirely oxeote, tips not reflexed. Dimensions (N = 75): 359.7 μm chord length (mean) (range 80–770 μm), 2.5 μm wide at centre (0.5–5 μm).

Isochelae — palmate. Dimensions (N = 100): 17.0 μm long (mean) (range 9–22 μm).

ECOLOGY

The present specimens were collected from a sand-gravel substrate. Previous records indicate that *A. ternatus* is generally found associated with sand and coral (Ridley 1884; Ridley and Dendy 1887; Keller 1889). The bathymetric distribution of this species extends from the intertidal zone (Lévi 1958) to a maximum depth of 80 metres (present study).

DISTRIBUTION

Acarnus ternatus appears to be widespread throughout the Indo-Pacific region, extending from the Red Sea (Keller 1889; Lévi 1958), Amirante Islands (Ridley 1884) and Kenya (Bruce

1976), to India and Sri Lanka (Ridley 1884; Dendy 1905), Indonesia and northeastern Australia (Ridley 1884; Kieschnick 1896; Thiele 1903; present study), to Tahiti (Ridley and Dendy 1887).

REMARKS

The specimens from Queensland are identified as *Acarnus ternatus* on the basis of having smooth cladotylotes of one category only. There is a close correspondence between that material and Ridley's syntype. Although several cladotylotes were observed with occasional scattered or single large spines on the shaft, this character was certainly unusual, and the majority of these spicules had smooth shafts. That condition was observed in the syntype also, although not recorded by Ridley (1884). Cladotylotes of the Queensland specimens were also unusual in sometimes having one or more small spines on the apex of clads, resembling multiple-clad spicules, and many having small clads only. These atypical characters were most evident in the smaller specimen (QM GL715), which also differed from the larger examples in shape (Fig. 47) (tubulo-digitate on a semi-encrusting base, versus flabellate semi-vasiform respectively), in having larger quantities of detritus on the ectosome and in the choanosome, and in the relative abundance of cladotylotes. The peculiar characteristics of the cladotylotes, the incorporation of numerous foreign particles into the skeleton and the atypical habit of specimen QM GL715 is probably of small consequence only, and on the basis of comparison with the type-specimen does not justify the separation of these 2 forms into distinct taxa. The details of skeletal architecture and fibre development, and the dimensions of spicules in all 3 specimens from the Great Barrier Reef correspond with details of the type-specimen and other records of *A. ternatus* within a reasonable range of variation (Table 4).

In having only one category of cladotylote, which is predominantly unspined, *A. ternatus* is placed in Lévi's (1963) group I *Acarnus*, to which may be added *A. tenuis* (see below).

Acarnus tenuis Dendy, 1896 (Table 5)

Acarnus tenuis Dendy, 1896, pp. 50–51.

MATERIAL EXAMINED

NMV G2456 (Dendy's RN 974), G2457 (RN 991): vicinity of Port Phillip Heads, Melbourne, Victoria, 38°20'S, 144°42'E; date of collection unknown, J.B. Wilson, dredge, (NMV G2456, encrusting on *Plumohalichondria arenacea*; G2457, encrusting on

TABLE 5. Comparison between published records of all species of *Acanus*, showing extreme ranges of spicule dimensions. Refer to text for sources of information. All measurements are given in micrometres, and denoted as length \times width.

CHARACTER	SPECIES					
	<i>A. thielei</i> Lévi	<i>A. tortilis</i> Topsent	<i>A. topsenti</i> Dendy	<i>A. ternatus</i> Ridley	<i>A. tenuis</i> Dendy	<i>A. erithacus</i> deLaubenfels
Colour alive/ (preserved):	light brown to orange	blackish to red	(dull grey)	blue, red to brown	(pale yellow)	red to bronze
Shape:	massive, digitate to lamellate/ vasiform	encrusting	digitate to flabellate	massive, rounded flabellate to branched on semi-encrusting base	thinly encrusting	encrusting
Skeleton:	renieroid to sub-renieroid	loosely reticulate	plumo-reticulate	renieroid to sub-renieroid reticulation	loosely reticulate	loosely reticulate
Styles:	178-464 \times 2-30 smooth base	214-550 \times 3-16 smooth and spined bases	204-287 \times 3-12 smooth and spined bases	128-450 \times 2-25 smooth base	180 \times 2	220-790 \times 7-43 smooth base
Acanthostyles:	absent	absent	absent	absent	absent	absent
Amphitylotes:	194-304 \times 1-9	222-440 \times 3.5-7	205-262 \times 2-3.5	192-280 \times 1.5-5	? absent	170-434 \times 3-8
Cladorylotes I:	85-272 \times 2-15 smooth shaft	151-225 \times 3-5 spined shaft	absent	63-275 \times 2-12 smooth shaft	160 \times 2 smooth shaft	180-472 \times 8-36 smooth shaft
Cladorylotes II:	75-97 \times 2-4 spined shaft	58-109 \times 2.5-4 spined shaft	53-97 \times 3-8 spined shaft	absent	absent	80-182 \times 3-7 spined shaft
Toxas I:	25-176 \times 1-9	44-130 \times 1-5	32-191 \times 1-4	12-266 \times 0.8-8	absent	40-645 \times 2-7
Toxas II:	34-960 \times 0.5-7	15-265 \times 1-2	absent	19-900 \times 0.5-5	absent	
Isochela:	8-29	7-22	9-12	8-22	absent	12-26
Locality:	Western Indian Ocean to Indo- Australian	Atlantic, Pacific and Indian Oceans	Western Indian Ocean	Indo-Pacific	Port Phillip, Victoria	Pacific Coast, North America

TABLE 5 (Cont.).

CHARACTER	SPECIES				
	<i>A. inominatus</i> Gray	<i>A. toxatus</i> Boury-Esnault	<i>A. bicladotylotus</i> Hoshino	<i>A. souriei</i> Lévi	<i>A. tener</i> Tanita
Colour alive/ (preserved):	orange to red	maroon	red-orange	bright orange to red	(red-brown)
Shape:	encrusting	encrusting	thinly encrusting	thinly encrusting	oval mass
Skeleton:	renieroid reticulation	?	irregular reticulation	plumose, halichondroid	plumo- reticulate
Styles:	175-459 × 6-22 smooth base absent	378-727 × 12-16 smooth base absent	195-394 × 6-12 spined base 80-95 × 3-5	170-381 × 3-10 spined base 6-145 × 2-5	260-340 × 8-10 spined base 80-130 × 4-6
Acanthostyles:					80-213 × 3-9 spined base
Amphitylotes:	130-283 × 2-6.3	213-472 × 3-9	205-310 × 3-6	119-357 × 2-7	350-473 × 3-4
Cladotylotes I:	180-295 × 6-14 smooth shaft	250-395 × 3-9 lightly spined	140-180 × 3-7 spined shaft	54-236 × 2-6 spined shaft	210-218 × 4.5-6 spined shaft
Cladotylotes II:	72-141 × 2-5 rare, spined shaft	56-162 × 3 heavily spined shaft	80-110 × 2-6 spined shaft	absent	absent
Toxas I:	21-249 × 1-5	28-75 × ?	60-110 × 1-2		a. 78-104 × 3-6 b. 143-204 × 1.5-3
Toxas II:	192-586 × 1.5-3	a. 218-265 × ? b. 500-945 × 2	130-210 × 2-3	45-330 × 2-4	230-309 × 1.5
Isochela:	6-24	12-14	15	12-21	19-22
Locality:	West Indies, South Africa, North Australia	Coast of Brazil, South Atlantic	Kyushu, Japan, East China Sea	Widespread, Northern Hemisphere	Noto Peninsula, Sea of Japan Coast of Brazil, South Atlantic

Tedania digitata). These specimens were noted as syntypes by Ayling *et al.* (1982) (see below).

Missing from collection: RN 1072, encrusting on *Clathria typica* (Ayling *et al.* 1982, p. 106; personal observation).

ECOLOGY

Unknown.

DISTRIBUTION

This species has been recorded only once, from Port Phillip Bay, Victoria.

REMARKS

Extensive examination of the two specimens held at the Museum of Victoria failed to discover any trace of the encrusting type specimens of *Acarinus tenuis*. Dendy (1896) notes that *A. tenuis* occurs as a small, thin, pale yellow crust on the surface of three sponges. Crusts do exist in quite extensive patches on the surface of G2456 and G2457 (*Crella incrustans* and *Tedania digitata*, respectively), but in all cases these encrustations consist of usual ectosomal spicules for these species (viz. oxeas, acanthoxeas and arcuate isochelae, and erect amphitylotes, respectively). It is apparent therefore that the type-specimens of *A. tenuis* no longer exist, at the Museum of Victoria.

Ayling *et al.* (1982) note that the British Museum (Natural History) holds three microscope slide preparations of each syntype (1902:10:18:62, 323, 375). Until these spicule mounts are re-examined, a definition of *A. tenuis* can be drawn from Dendy's (1896) description only (Table 5). This species may be differentiated from other *Acarinus* in having no microscleres, no fibres, a very loose irregular reticulation of styles or subtylostyles ($189 \times 2 \mu\text{m}$), and scattered or loose bundles of cladotylotes ($160 \times 2 \mu\text{m}$), bearing 5 clads (approximately $4 \mu\text{m}$ in length) with unspined shafts. Amphitylotes are apparently absent also.

Lévi (1963) omits *A. tenuis* from his subdivision of the genus, but on the basis of the cladotylote morphology it would fit with his group I *Acarinus*, together with *A. ternatus*. Dendy (1922) suggests that the absence of chelate microscleres in this species may be cause to erect a separate genus for *A. tenuis*, but such a move could not be justified for such a poorly known species.

SYNOPSIS OF OTHER SPECIES

Brief diagnoses are given below of other species of *Acarinus* not found in the Australian region. Table 5 provides a summary of the main diagnostic characters for each.

Acarinus erithacus de Laubenfels, 1927 (Table 5)

Acarinus erithacus de Laubenfels, 1927, pp. 258-60, 262, text-figs 1,2,9,10,11. de Laubenfels, 1930, p. 104. de Laubenfels, 1932, pp. 104-7, text-fig. 63. Dickinson, 1945, p. 20. Bakus, 1966, pp. 468-71, text-figs 14a-j. Schwab and Shore, 1971, pp. 125-36. Shore, 1972, pp. 689-98. Carter and Rinehart, 1978, pp. 4302-4. Hofknecht, 1978, pp. 53-4.

DIAGNOSIS

Brilliant red to bronze, thinly to massively encrusting sponge with an irregular, microconulose, hispid surface and an irregular, loosely reticulate skeleton of ascending spicule tracts. Spongin fibres are light, cored by styles ($200-790 \times 7-43 \mu\text{m}$), and echinated by cladotylotes of 2 varieties: I—($180-472 \times 8-36 \mu\text{m}$) have 3-4 clads and smooth shafts; II—($80-182 \times 3-7 \mu\text{m}$) have spined shafts. Tangential ectosomal amphitylotes ($170-434 \times 3-8 \mu\text{m}$) with microspined tips. Toxas of 2 sizes: I—small, thick and reflexed; II—long, thin and mostly straight or only slightly curved (both $40-645 \times 2-7 \mu\text{m}$). Palmate isochelae ($12-26 \mu\text{m}$) core light spongin between the fibres.

Source: de Laubenfels (1927, 1932), Bakus (1966).

ECOLOGY

Associated with rock, dead corals, and living or dead barnacles; extensive bathymetric range from the intertidal zone to 700 metres depth.

DISTRIBUTION

Pacific coast to North America (California, Washington).

REMARKS

Acarinus erithacus was placed in group III *Acarinus*, together with *A. thielei* and *A. innominatus* on the basis of its smooth and spined cladotylotes (Lévi 1963). It is close to *A. tortilis* in skeletal architecture, but differs from that species in cladotylote morphology and spongin content (Bakus 1966) (Table 5). The affinities of this species, and arguments for a possible combination of Lévi's group III species have been presented earlier.

Acarinus topsenti Dendy, 1922 (Fig. 37, Table 5)

Acarinus topsenti Dendy, 1922, pp. 98-9, pl. 4, fig. 3a-b, pl. 15, fig. 8a-c. Burton 1959, p. 253.

MATERIAL EXAMINED

SYNTYPE: BM 1921.11.7.84: Cargados Carajos, north of Mauritius, Indian Ocean, 16°25'S, 59°36'E, 60 m depth, 29 August 1905, H.M.S. 'Sealark', dredge.

REDESCRIPTION OF TYPE-SPECIMEN

DETAILS OF EXTERNAL MORPHOLOGY: Digitate to flabellate sponge with digitiform processes and microconules on the surface. Surface is roughened and microscopically hispid. Ectosome has a thin, translucent membrane covering, and small oscula on the margins of branches. Texture is compressible, fibrous and fairly tough. Colour in ethanol ranges from dull grey to reddish or purplish (Dendy 1922, p. 98).

ECTOSOME: Choanosomal fibres ascend to the ectosomal region and form erect microconulose projections. Ascending fibres are cored by plumose tracts of styles, with the ultimate brushes poking through the surface and forming an irregular, erect palisade of spicules. In addition to a hispid ectosomal layer of styles, there is a fine tangential ectosomal layer of amphitylotes, in bundles of up to 10 spicules abreast or scattered singly. The tangential ectosomal layer is conspicuous in some areas, but difficult to observe in other areas due to the presence of relatively heavy deposits of detritus on the ectosome. Amphitylotes are scattered throughout the mesohyl of the choanosome also.

CHOANOSOME: The overall choanosomal skeletal architecture is plumo-reticulate, with distinctive ascending fibre tracts (30–50 μm in diameter), which diverge in plumose fashion towards the subectosomal region (Fig. 37). Fibres consist of relatively heavy spongin, resembling those of the Spongiidae. Ascending fibres are cored by plumose tracts of principal styles, 4–10 spicules abreast, occasionally singly, which ultimately protrude through the ectosome, and are echinated by cladotylotes in moderate concentrations. Ascending (cored) fibres are connected in a loose reticulation by transverse uncored fibres of similar diameter. Transverse fibres are only lightly echinated by cladotylotes or not at all. The mesohyl matrix contains relatively heavy deposits of granular spongin bearing microscleres and scattered amphitylotes. No styles were observed outside spongin fibres. Meshes formed by anastomosing fibres are variable in diameter, 90–290 μm . Detritus is moderately abundant between fibres, and consists mainly of sand grains.

MEGASCLERES (N=25): Principal styles — hastate, tapering to a sharp point, relatively straight or only slightly curved at the centre, with

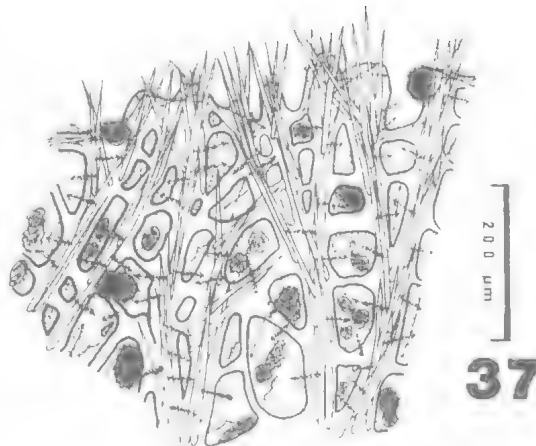


FIG. 37: *Acarnus topsenti*, syntype; perpendicular section of peripheral skeleton.

evenly rounded or only slightly subtylote bases; bases smooth or very lightly microspined. 223.7 μm long (mean) (range 204–287 μm), 7.8 μm wide (3–12 μm).

Amphitylotes — relatively long, thin, straight, with slightly swollen tylote bases bearing microspines on their tips. 227.4 μm long (mean) (range 205–262 μm), 2.5 μm wide (2–3.5 μm).

Cladotylotes — relatively small, thin, straight, thicker near base than on clad end, with profusely microspined shafts and a bare anterior area immediately below clads; clads are relatively short, and number 4 to 5; bases are slightly subtylote, with 3–4 large recurved spines. 76.7 μm shaft length (mean) (range 53–97 μm), 5.1 μm shaft width (3–8 μm), 6.3 μm clad chord length (3–11 μm), 8.9 μm wide at clad end (5–14 μm).

MICROSCLERES (N=25): Toxas 1 — short to long and thick, generously curved at the centre, with recurved tips, 112.2 μm long (mean) (range 32–191 μm), 2.3 μm wide (1–4 μm).

Isochelae — small, thin, palmate, 10.7 μm long (mean) (range 9–12 μm).

ECOLOGY

A moderately deeper-water species, with a bathymetric distribution of 38–165 metres; apparently associated with a red algae (*Lithothamnion*) (Burton 1959).

DISTRIBUTION

Western Indian Ocean (Coast of Oman, Arabian Sea; Cargados Carajos, north of Mauritius, Indian Ocean).

REMARKS

Dendy (1922, p. 15, fig. 8) provides adequate drawings of the spicule morphology of *A. topsenti*, and those do not need to be repeated here. Fig. 37 shows the skeletal architecture of this species, which has not been illustrated previously. The supposed absence of a tangential ectosomal skeleton of amphitylotes, reported by Dendy (1922) was not supported by the re-examination of the type-specimen, and in that respect *A. topsenti* does not differ from other *Aacarnus* species.

Aacarnus topsenti is placed in Lévi's (1963) group II *Aacarnus* by the presence of spined cladotylotes only, and in this respect the species has affinities with *A. tortilis* and *A. toxtatus*. Arguments have been presented above in support of maintaining *A. topsenti* and *A. tortilis* as distinct species, despite their very close similarities.

***Aacarnus toxtatus* Boury-Esnault, 1973**
(Table 5)

Aacarnus toxata Boury-Esnault, 1973, p. 285, text-fig. 44.

DIAGNOSIS

Maroon, thinly encrusting sponge with a delicate detachable ectosomal crust. Surface is hispid. Choanosomal skeletal architecture is unknown, but presumably greatly reduced as a result of its thin habit. Styles have slightly swollen, smooth bases ($378\text{--}727 \times 12\text{--}16 \mu\text{m}$). Ectosomal amphitylotes ($213\text{--}472 \times 3\text{--}9 \mu\text{m}$) with spined extremities. Cladotylotes of 2 varieties: I—($250\text{--}395 \times 3\text{--}9 \mu\text{m}$) have 6 clads and a lightly spined shaft; II—($56\text{--}162 \times 3 \mu\text{m}$) have a heavily spined shaft. Toxas of 3 varieties: I—($28\text{--}75 \mu\text{m}$) short, relatively thick, with reflexed tips and generously curved centrally; II—($218\text{--}265 \mu\text{m}$) moderately long, slightly reflexed and curved at centre; III—($500\text{--}945 \mu\text{m}$) relatively thin, long, straight, not reflexed at tips. Palmate isochelae $12\text{--}14 \mu\text{m}$ long.

Source: Boury-Esnault (1973).

ECOLOGY

Habitat unknown. Collected from 50 depth.

DISTRIBUTION

Single locality, off Governador Valadares, Brazil, South Atlantic.

REMARKS

Aacarnus toxtatus is placed in Lévi's (1963) group II *Aacarnus* in having spined cladotylotes only. The species is distinctive in the extreme size of toxas (Table 5), but the division of toxas into three varieties may be artificial. Toxa II probably

represents an intermediate between the smaller, curved form and the long, straight form.

***Aacarnus bicladotylotus* Hoshino, 1981**
(Table 5)

Aacarnus bicladotylota Hoshino, 1981, pp. 142–3, text-fig. 60, pl. 6, fig. 4.

DIAGNOSIS

Thinly encrusting, red-orange sponge, with a smooth surface containing foreign particles. Ectosome with a confused tangential layer of amphitylotes ($205\text{--}310 \times 3\text{--}6 \mu\text{m}$) bearing spines on extremities. Choanosomal skeletal architecture irregularly reticulate with ascending spicule tracts cored by styles ($195\text{--}394 \times 6\text{--}12 \mu\text{m}$), and echinated by cladotylotes of 2 varieties: I—($140\text{--}180 \times 3\text{--}7 \mu\text{m}$); II—($80\text{--}110 \times 2\text{--}6 \mu\text{m}$), both with spined shafts. Acanthostyles ($80\text{--}95 \times 3\text{--}5 \mu\text{m}$) erect on basal membrane of sponge. Toxas of 2 varieties, both thin and reflexed: I—($60\text{--}100 \times 1\text{--}2 \mu\text{m}$); II—($130\text{--}210 \times 2\text{--}3 \mu\text{m}$).

Arcuate (?) isochelae ($15 \mu\text{m}$) coring abundant spongin between the fibres.

Source: Hoshino (1981).

ECOLOGY

Associated with barnacles (*Acasta*); located in the intertidal zone to shallow subtidal regions.

DISTRIBUTION

East China Sea (Matsushima Maeshima, Ariake Sea, Kyushu, Japan).

REMARKS

In habit and skeletal structure (ascending plumose tracts), *A. bicladotylotus* resembles *A. erithacus*, but differs from that species and other *Aacarnus* by the dimensions and composition of the skeletal components (Table 5).

This species is a member of the nominal subgenus *Acanthacarnus* by virtue of a basal layer of acanthostyles in the skeleton, acanthose cladotylotes only, and thin styles. Although Hoshino (1981) records the isochelae as arcuate, his figure (60f) suggests that they are probably palmate, which is consistent with other species of *Aacarnus*.

***Aacarnus souriei* (Lévi, 1952)**
(Table 5)

Acanthacarnus souriei Lévi, 1952, p. 54, text-figs 18–19. Lévi, 1959, pp. 132–3, text-fig. 25. Vacelet, 1961, p. 42. Hechtel, 1965, p. 40. Thomas, 1970, pp. 46–50, text-figs 1–2a–h. Thomas, 1973, p. 30, pl. 2, fig. 2.

Acanthacarnus levii Vacelet, 1960, pp. 267-9, text-fig. 5.

Acarnus souriei: Van Soest, 1984, pp. 63-5, text-fig. 23.
DIAGNOSIS

Bright orange to red, thinly encrusting sponge, with an optically smooth, microscopically hispid surface. Ectosome with an irregular tangential layer of amphitylotes ($119-357 \times 2-7 \mu\text{m}$) bearing terminal spines. Choanosome skeletal architecture lightly reticulate only and more markedly halichondroid, with ascending plumose spiculo-spongin fibres. Spongin fibres are light, cored by styles ($170-381 \times 3-10 \mu\text{m}$) and echinated by acanthostyles ($60-145 \times 2-5 \mu\text{m}$) and cladotylotes of 1 variety only, with 4 clads and spined shafts ($54-236 \times 2-6 \mu\text{m}$). Toxas of at least 2 varieties: I— with reflexed tips, generously curved, and of variable thickness; II— thin, angular central curvature, long (both: $45-330 \times 2-4 \mu\text{m}$). Palmate isochelae ($12-21 \mu\text{m}$).

Source: Lévi (1952, 1959), Hechtel (1965). Thomas (1970, 1973), Van Soest (1984).

ECOLOGY

Apparently restricted to dead coral and rock substrate; bathymetric distribution from the intertidal zone to 10 metres depth.

DISTRIBUTION

Predominantly northern hemisphere, widespread; Mediterranean (Corsica), North Atlantic Ocean, West Africa (Senegal, Gulf of Guinea), Indian Ocean (Seychelles, Palk Bay, Gulf of Manaar), Caribbean (Curaçao, Barbados, Puerto Rico, Jamaica).

REMARKS

Acarnus souriei s.l. has a wide range of spicule measurements, particularly for the cladotylotes. Vacelet (1960) and Thomas (1970, 1973) divide cladotylotes of specimens from the Mediterranean and Indian Ocean (respectively) into two size categories, both of which are spined (I— $80-210 \times 4.5-6 \mu\text{m}$; II— $54-140 \times 2-4 \mu\text{m}$), but other authors group these spicules into a single (albeit variable) category (Vacelet 1961; Hechtel 1965; Van Soest 1984). Van Soest (1984) notes other differences in skeletal components between the various populations of *A. souriei*. It is evident that the species is highly variable over its large geographical range, and consequently it is difficult to isolate any single character which separates this species from others (Table 5). Van Soest (1984) suggests that *A. bicladotylotus* may be distinguished from *A. souriei* in having 2 sizes of cladotylotes (see Table 5), but both forms fall well within the range of those of *A. souriei*. The same

argument applies for all spicule components of *A. tener*. *Acarnus radovani* is maintained here as a separate species, with question, in having larger amphitylotes with only slightly swollen ends, although Van Soest (1984) suggests that it is close to, and probably synonymous with *A. souriei*. That distinction is tenuous, and probably artificial, but the combination of *A. radovani* and *A. souriei* would provide sufficient reason to synonymize all *Acarnus* (*Acanthacarnus*) species on the basis of similarities in spicule morphology and size. This problem of clearly and objectively differentiating *Acarnus* species has been encountered earlier (*A. innominatus* and *A. thielei*, *A. topsenti* and *A. tortilis*), and on the basis of morphological characters alone no easy solution is presently available. Combinations of specific characters, such as habit, architecture and spicule morphology must be used together in distinguishing species, taking into account known ecophenotypic differences between populations, and in some cases subjective criteria are as equally important (e.g. colour, texture, gross morphology and the appearance of the ectosome).

Acarnus radovani (Boury-Esnault, 1973) (Table 5)

Acanthacarnus radovani Boury-Esnault, 1973, p. 284, text-fig. 43.

DIAGNOSIS

Deep violet (in preserved state), encrusting sponge, with hispid surface. Ectosomal and choanosomal skeletal structure is unknown. Ectosomal amphitylotes with only slightly swollen ends which are terminally spined ($350-473 \times 3-4 \mu\text{m}$). Styles with spined bases, slightly subtylote acanthostyles abundant with numerous small spines on shaft (both styles and acanthostyles: $80-213 \times 3-9 \mu\text{m}$). Cladotylotes of 1 variety, with spined shafts ($210-218 \times 4.5-6 \mu\text{m}$). Toxas of at least 2 varieties: I— with reflexed tips, a generous central curvature and relatively thick ($78-104 \times 3-6 \mu\text{m}$); II— thin, oxeote, with slight central arch ($230-309 \times 1.5 \mu\text{m}$). A third variety of toxa, probably an intermediate stage is recorded ($143-204 \times 1.5-3 \mu\text{m}$). Palmate isochelae abundant in heavy deposits of spongin ($19-22 \mu\text{m}$).

Source: Boury-Esnault (1973).

ECOLOGY

Habitat unknown; collected from 51 metres depth.

DISTRIBUTION

Tropical Atlantic Ocean (off Recife, Brazil, South Atlantic).

REMARKS

Boury-Esnault (1973) differentiates this species from other *Acarus* (*Acanthacarus*) by the large size of the spicules and by the presence of 3 sizes of toxas. A comparison with other species (Table 5) shows that most spicule forms fall within the upper size range of most other species, particularly the widespread *A. souriei*. Van Soest (1984) records *A. souriei* with similar categories of toxas as *A. radovani*, which supports his suggestion that the two may be synonymous, but they are presently maintained as distinct species for reasons discussed above. In general, *A. radovani* has larger amphitylotes and cladotylotes than does *A. souriei*.

***Acarus tener* Tanita, 1963**
(Table 5)

Acarus tenerus Tanita, 1963, pp. 123–4, pl. 4, fig. 2, text-fig. 2. Hoshino, 1981, p. 144.

DIAGNOSIS

Dull reddish-brown (in preserved state), oval sponge, more-or-less 'dorso-ventrally' compressed, with a lightly hispid surface. Surface is rough; ectosome with a tangential layer of amphitylotes, with terminal swellings and spines on apices ($180\text{--}320 \times 2.5\text{--}5 \mu\text{m}$). Choanosomal skeletal architecture is plumo-reticulate, and slender fibres are cored by styles with basal spination ($260\text{--}340 \times 8\text{--}10 \mu\text{m}$). Fibres echinated by numerous acanthostyles ($80\text{--}130 \times 4\text{--}6 \mu\text{m}$) and cladotylotes of 1 variety, with spined shafts and 4 clads ($130\text{--}190 \times 5\text{--}6 \mu\text{m}$). Toxas generously curved at center with reflexed tips ($70\text{--}110 \times 2 \mu\text{m}$). Palmate isochelae $12\text{--}14 \mu\text{m}$ long.

Source: Tanita (1963).

ECOLOGY

Growing amongst seaweed (*Laurencia*); depth recorded as shallow to moderately shallow water.

DISTRIBUTION

Japan (Noto Peninsula, Sea of Japan).

REMARKS

Tanita (1963) erected this species on the basis of its shape and the presence of echinating acanthostyles. Those characters are now of little value in separating species, but *A. tener* can be differentiated from *A. bicladotylotus* in having only a single category of cladotylote and toxa (Table 5). It is close to *A. souriei* s.l. but differs from that species in skeletal architecture.

DISCUSSION

The intraspecific variability in morphological characters shown by some *Acarus* makes the specific taxonomy of this group difficult and unreliable. Limited studies have shown that some characters in some species are unstable. Most significantly, de Laubenfels (1932), Thomas (1970) and Van Soest (1984) found that cladotylotes were sometimes absent from specimens of *A. erithacus* and *A. souriei*. Furthermore, Van Soest (1984) noted that acanthostyles were absent from one Caribbean specimen of *A. souriei*. Those authors were able to assign aberrant specimens to a specific taxon through morphological comparisons with other material from the same localities. Although atypical specimens are reportedly not abundant, there exists the possibility that records of single specimens from isolated localities, such as *A. innominatus* from Darwin, represent specimens with reduced characteristics. Unfortunately there is no solution to this problem on the basis of known material, and in using a limited number of morphological characters of undetermined stability. Populations of *Acarus* species are not abundant in any locality, with the possible exception of *A. erithacus* from the Pacific coast of North America, so it is unlikely that a study of intraspecific variability, would be successful for this group.

Nevertheless, accepting the limitations of the data, it is possible to speculate further on species relationships and the zoogeography of *Acarus*. Conclusions derived from these analyses cannot be fully corroborated because conspecificity has been assumed from the literature, and not in comparison with type-specimens (e.g. Wiedenmayer 1977). That material was not available to the author.

In following with current taxonomic procedures, the important diagnostic characters for the genus are the size, morphology and distribution of the echinating cladotylotes, toxas, and ectosomal amphitylotes, the basal feature of choanosomal styles, the presence or absence of echinating acanthostyles, the overall skeletal architecture, and the gross morphology of the sponge. Other more subjective criteria, such as the colour alive, the macroscopic appearance of the ectosome, and the degree of infiltration of detritus into the choanosome are also important in distinguishing allied species. On this basis, it is possible to separate 12 species. However, many of those species are encrusting in habit, with a concomitant reduction in skeletal architecture, and consequently the value of some diagnostic

characters is diminished. As a result, the morphology of the cladotylote megasclere remains the principal characteristic for differentiating species. Lévi's (1963) proposal for subdividing *Acarnus* on the basis of cladotylote form offers a convenient and practical method to facilitate identifications. He omits *A. tenuis* from his scheme, possibly with good reason due to the poorly known characteristics of that species, but it is included here on a provisional basis, as it represents the only record of the group from temperate Australian waters.

GROUP I: with only smooth shafts on cladotylotes

- A. ternatus* Ridley
- A. tenuis* Dendy

GROUP II: with only spined shafts on cladotylotes
IIA— without echinating acanthostyles

- A. tortilis* Topsent
- A. topsenti* Dendy
- A. toxatus* Boury-Esnault

IIB— with echinating acanthostyles (subgenus *Acanthacarnus*)

- A. bicladotylotus* Hoshino
- A. souriei* (Lévi)
- A. radovani* (Boury-Esnault)
- A. tener* Tanita

GROUP III: with both smooth and spined cladotylotes

- A. erithacus* de Laubenfels
- A. innominatus* Gray
- A. thielei* Lévi

It is clear that some species are more closely related than others. Using a restricted set of morphological characters (Table 6), it is possible to construct a cladogram to illustrate these relationships (Fig. 38). Each number on the cladogram indicates an evolutionary change of the corresponding character from a relatively plesiomorphic to a relatively apomorphic state. The apomorphic character states were judged on a number of criteria (Table 6, mainly after Van Soest 1984, pp. 65, 151), the most significant of which are the reduction of cladotylote and acanthostyle megascleres.

From Fig. 38, the basic separation of the three groups is indicated (characters 1,2), which corresponds to Lévi's (1963) subdivision of the genus. From this particular analysis, it is suggested that species formerly included in the genus *Acanthacarnus* are more closely related to *Acarnus* group IIA species than previously recognized when

using the presence or absence of acanthostyles as the primary characteristic for subdividing the genus. Supporting evidence for this opinion is suggested by the synplesiomorphy of basal spination of choanosomal styles, and the synapomorphy through reduction of the smooth cladotylote megascleres.

Group III species are subdivided on the basis of growth form (No. 3; a character of undetermined stability and questionable importance), and the proportion of acanthose and smooth cladotylote megascleres (No. 4). *Acarnus erithacus* and *A. innominatus* are more plesiomorphic than *A. thielei*. Synplesiomorphic characters which unite Group IIB species (viz. the possession of acanthostyles, spined cladotylotes only, and the basal spination of styles) are more obvious than any apomorphic separation of that group. Synapomorphy for *A. tener* and *A. radovani* is the possession of one category of spined cladotylote spicule only (No. 6). No derived characters are presently known to separate those two species in this analysis, because the ectosomal and choanosomal characteristics of *A. radovani* are unknown. *Acarnus topsenti* and *A. tortilis* (Group IIA) are related to Group IIB species by the retention of ancestral characters (Nos. 2,8), which is not clear from this analysis, whereas *A. toxatus* seems to have lost the basal spination on styles. That condition may have arisen independently, as it is synapomorphic for *Acarnus* Groups I and III.

Five *Acarnus* species are now known from Australian waters, three of which represent new locality records (*A. thielei*, *A. innominatus*, and *A. tortilis*). *Acarnus ternatus* is well known throughout the Indo-Pacific region, but its distribution in Australia is restricted to the tropics. *Acarnus tenuis* was recorded from the Tasman Sea, but the species is poorly known. Until redescrptions are made of the presently missing type-specimens, or more preferably, redescrptions based on fresh material, *A. tenuis* becomes a species inquirenda.

Several zoogeographical patterns are indicated for *Acarnus* species (Fig. 39). Of Group I species, *A. ternatus* shows a separation into two disjunct populations: Western Indian Ocean, and Indo-Pacific, but conspecificity of the two populations seems to be clear on the basis of morphological characteristics. In following with standard taxonomic procedures, Group I species should be referred to as the *ternatus* species group.

The major component of Group IIA species, *A. tortilis* has three discontinuous populations.

TABLE 6. Characters used in the construction of Fig. 38. Criteria for judging apomorphy are listed below.

PLESIOMORPHIC STATE	APOMORPHIC STATE
1. At least one category of cladotylote megascleres with spined shafts	1. A single category of cladotylote megascleres with smooth shafts only
2. Two varieties of cladotylotes (spined and smooth)	2. Smooth cladotylotes not present
3. Growth from encrusting	3. Digitate, flabellate, or vasiform habit
4. Cladotylote megascleres are predominantly acanthose	4. Acanthose cladotylotes are rare
5. Acanthostyles present	5. Acanthostyles absent
6. Two size-categories of acanthose cladotylotes	6. One size-category of acanthose cladotylotes
7. Toxa microscleres are diverse in form and size, with at least 3 categories	7. Reduced complement of toxas, and relatively thin
8. Choanosomal styles or subtylostyles with microspined bases	8. Styles or subtylostyles with smooth bases
9. Strongly developed (horny) spongin fibres	9. Fibres reduced, lightly invested with spongin only
10. Ectosomal amphitylotes form a more-or-less tangential layer	10. Amphitylotes absent

Cladotylotes: In the plesiomorphic state, cladotylotes have both smooth and spined shafts, representing 2 separate categories of megascleres, and in the apomorphic state one of the varieties is lost. A reduction in the proportion of spined versus smooth cladotylotes, and the number of varieties of spined cladotylotes is considered here as a further derived condition.

Acanthostyles: The retention of acanthostyles echinating a layer of basal spongin and/or spiculo-spongin tracts is interpreted as an ancestral condition (Van Soest 1984).

Styles: The presence of microspines on bases of choanosomal styles or subtylostyles is considered here as a plesiomorphic condition.

Amphitylotes: The possession of a tangential ectosomal skeleton of tylote megascleres is shared with other myxillids, and at least one other family of Poecilosclerida (Van Soest 1984), and is probably an ancestral character. Synapomorphy is the secondary reduction or loss of amphitylotes.

Habit: An encrusting growth form is considered here as plesiomorphic, and development of digitate, flabelliform or vasiform habit is probably a derived condition. This distinction may be illusory, as the stability of this character has not been determined in any study, and ecophenotypic factors and individual maturation must be considered (see text).

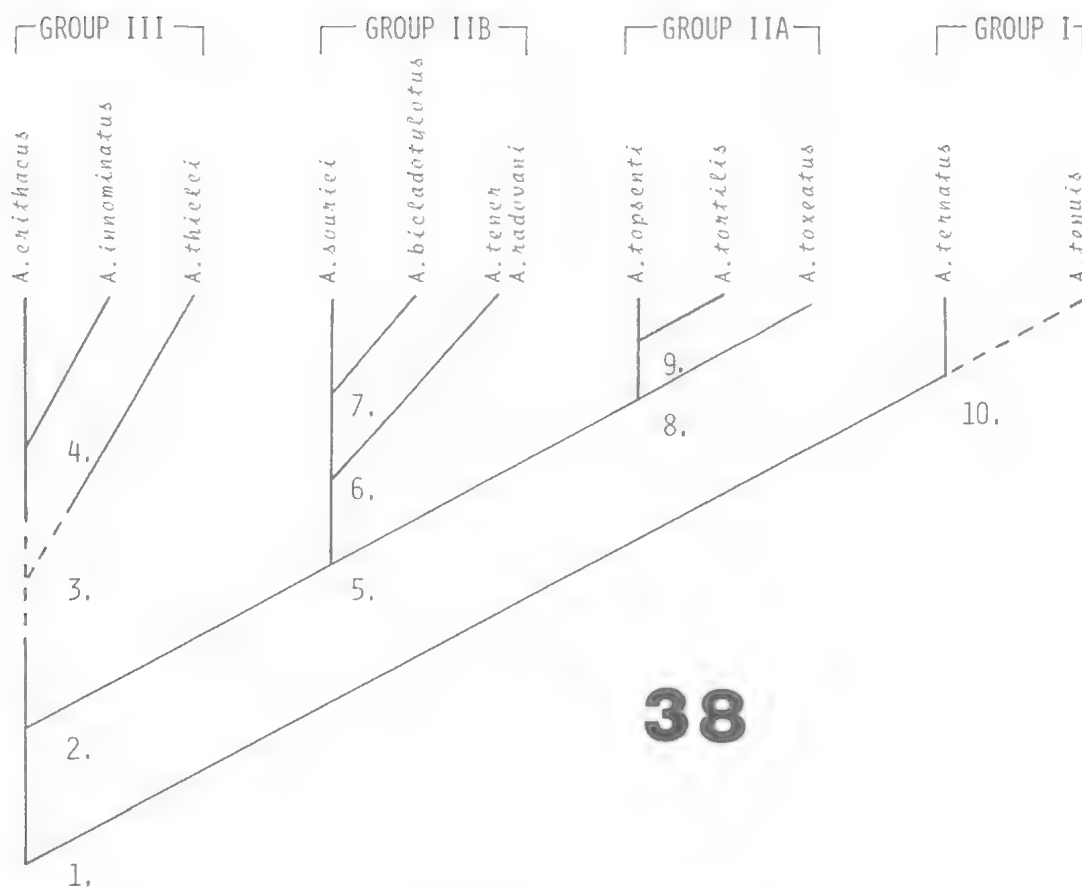
Skeletal architecture and fibre development: Van Soest (1984, p. 151) suggests that a reticulate or plumo-reticulate skeletal architecture is probably an ancestral condition, shared with several outgroups of the Poecilosclerida. Similarly, skeletal fibres which are heavily invested with type B spongin is interpreted here as the plesiomorphic state. The importance of this character is debatable (see text), as ecophenotypic factors influencing growth form and the consequent skeletal development are probably critical.

Microscleres: Synapomorphy for the Poecilosclerida s.s. are the chelate microscleres, but synplesiomorphy is probably a full and diverse complement of other microscleres, including toxas (Van Soest 1984, p. 151). A reduction in heterogeneity of non-chelate microscleres is considered here as an apomorphic condition.

extending into both northern and southern hemispheres: North Atlantic-Mediterranean, Western Indian Ocean, and Indo-Pacific populations. It is difficult to determine any intraspecific variability corresponding to these zoogeographical populations, on the basis of known material, because only few published accounts of *A. tortilis* describe morphological

characteristics (see Table 3). There appears to be a trend in size reduction of styles from the Mediterranean to Indo-Pacific populations (400–515, 300–450, 214–334 μm long respectively for the three populations), but that pattern requires confirmation from additional data.

The distribution of *A. topsenti* is sympatric with the Western Indian Ocean population of *A.*



38

FIG. 38: Cladogram of the relationships between species of *Acarnus*. Each number on the cladogram indicates an evolutionary change of the corresponding character (Table 6) from a relatively plesiomorphic to a relatively apomorphic state.

tortilis, which is further evidence in support of a possible combination of the two species (cf. above, and Vacelet *et al.* 1976). *Acarnus toxoatus* is known from a single locality only (tropical South Atlantic Ocean). *Acarnus* group IIA species should be referred to as the *tortilis* species group.

Group IIB species are found predominantly in the northern hemisphere. *Acarnus souriei* has a disjunct zoogeography, with the separation of three populations: Caribbean, Mediterranean-West African, and central Western Indian Ocean. Van Soest (1984, p. 64) suggests that the Caribbean and Mediterranean-West African populations are clearly conspecific, although he notes that the Mediterranean specimens have larger styles and amphitylotes than the tropical specimens. The Indian Ocean population is recorded as having a lower size range of cladotylote megasclere than the

Atlantic region populations (54–187, 70–236 μm respectively), but this is probably of minor taxonomic significance. Isochela microscalers are relatively homogeneous in size throughout the entire geographical range of this species. Van Soest (1984) also supports a possible combination of *A. radovani* and *A. souriei* on the basis that spicule sizes for both species correspond closely. Populations of *A. souriei* which are geographically closest to *A. radovani* (viz. Caribbean and West African specimens) have significantly smaller amphitylotes (119–357, 350–473 μm long respectively), and in that respect *A. radovani* is most similar to Mediterranean specimens of *A. souriei* (which have amphitylotes 280–408 μm long). It is possible that the variability is taxonomically insignificant, and that the two species are conspecific, but for reasons discussed

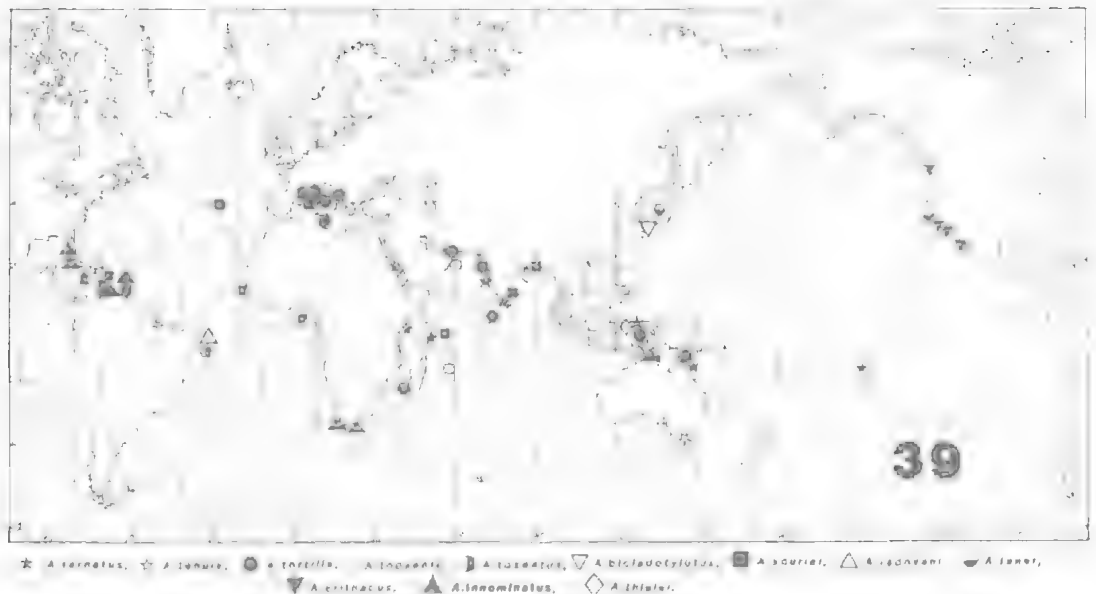


FIG 39: Zoogeography of *Acarnus* species. Conspicuity is assumed from the literature. Refer to text for sources of information.

earlier their specific separation is maintained here. Other species in Group IIB, *A. bicladotylotus* and *A. tener* are known only from the Japan region. Group IIB species should be referred to as the *scuriei* species group in preference to subgenus *Acanthacarnus*, as the latter term implies a greater degree of taxonomic distance than recognized here.

Group III is represented by one endemic species, *A. erithacus* from the Pacific Coast of North America, and two other species with more widespread distributions. *Acarnus innominatus* is widely separated with three discontinuous populations: Caribbean-Gulf of Mexico, temperate South Atlantic-Indian Ocean, and Indo-Pacific. There is a relatively homogeneous distribution of morphological characteristics throughout the range of this species, although the specimen from the Arafura Sea region is more similar to the Caribbean population than to the South African specimens in spicule sizes. More detailed studies on encrusting sponge faunas throughout the Indian Ocean region may show that this species has a more extensive distribution than is presently known. *Acarnus thielei* has a relatively contiguous distribution across the western Indian Ocean to the Indo-Pacific, but there seems to be two populations within that range. Indian Ocean specimens have small

isochelae (8–10 μm long), whereas isochelae of the Indo-Pacific specimens are larger (18–25 μm long) (see also Lévi 1958). *Acarnus innominatus* is most representative of Group III species, and that group should be known as the *innominatus* species group.

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FIG. 40: *Acarnus thielei*; exterior surface of specimen NTM Z855, showing numerous raised surface projections.

41

50 mm

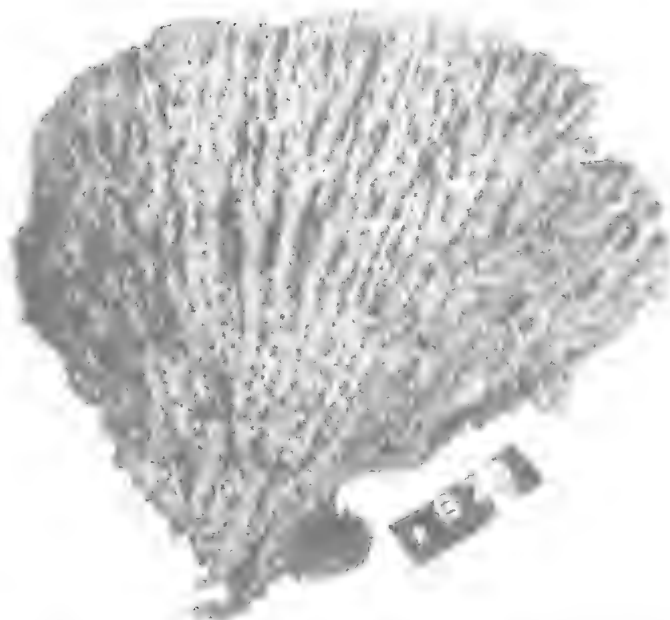


FIG. 41: *Acarnus thielei*; exterior surface of specimen NTM Z876, showing raised longitudinal surface ridges.

42

50 mm



FIG. 42: *Acarnus thielei*; interior surface of specimen NTM Z876, showing relatively smooth, porous surface.



FIG. 43. *Acarnus thielei*; photomicrograph of perpendicular section through choanosome of specimen NTM Z876.

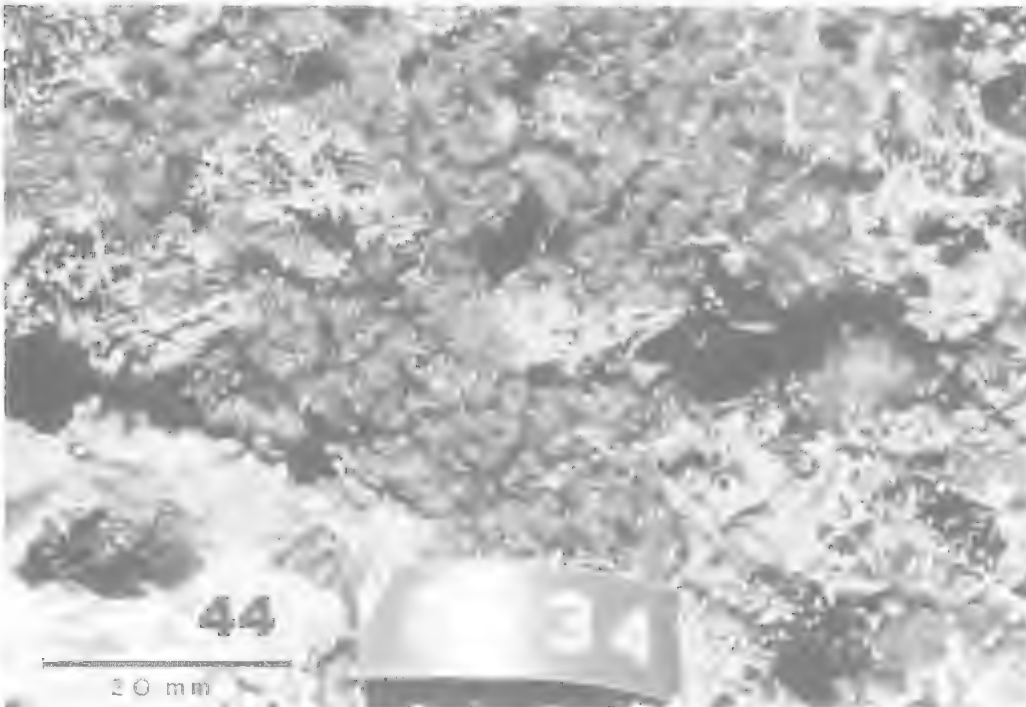


FIG. 44. *Acarnus innominatus*; encrusting specimen NTM Z2234 *in situ* on dead coral substrate.

45

20 mm



FIG. 45. *Acarnus tortilis*; encrusting specimen QM GL1538.

46

30 mm

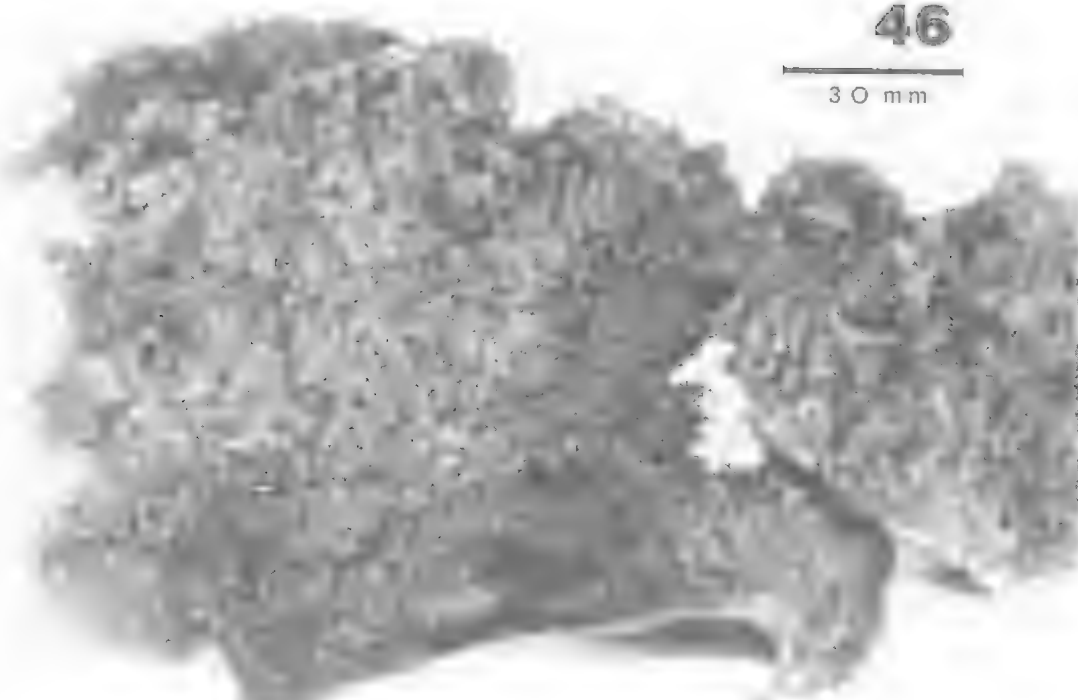


FIG. 46. *Acarnus ternatus*; exterior surface of lamellate specimen QM GL2773.



FIG. 47. *Acarnus ternatus*; atypical bulbous-digitate specimen QM GL715.

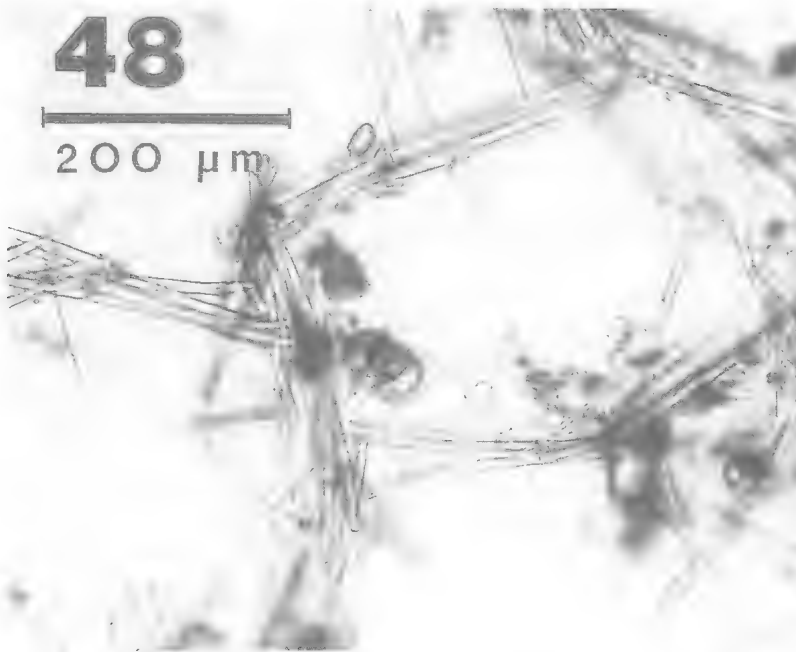


FIG 48. *Acarnus ternatus*; photomicrograph of cross-section through choanosome (specimen QM GL715), showing isodictyal reticulation of spiculo-spongin fibres lightly echinated by cladotylotes, and the cavernous architecture.

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CRASPEDOSOMID MILLIPEDES DISCOVERED IN AUSTRALIA:
REGINATERREUMA, *NEOCAMBRISOMA* AND *PETERJOHNSIA*, NEW GENERA
(MYRIAPODA: DIPLOPODA: CRASPEDOSOMIDA)

JEAN-PAUL MAURIÈS
Muséum National d'Histoire Naturelle de Paris

ABSTRACT

The order Craspedosomida has been discovered in Australia (Great Dividing Range) and three new genera are described. Both *Reginaterreuma* (from NE Queensland) and *Neocambrisoma* (from NE New South Wales) belong to the suborder Chordeumidea (known also in New Zealand and New Guinea) and the latter is the type genus of a new family. *Peterjohnsia*, also the type genus of a new family, was collected in the Bellenden Ker Range (NE Queensland) and is the first representative of the suborder Craspedosomoidea to be found in the southern Hemisphere.

RÉSUMÉ

Pour la première fois, l'ordre des Craspedosomides est signalé en Australie (Great Dividing Range) par trois genres nouveaux. *Reginaterreuma* (du N.E. du Queensland) et *Neocambrisoma* (du N.E. des Nouvelles Galles du Sud), ce dernier génératype d'une famille nouvelle, appartiennent au sous-ordre des Chordeumidea (connu de Nouvelle-Zélande et de Nouvelle-Guinée). *Peterjohnsia*, également génératype d'une nouvelle famille, a été récolté dans les montagnes du Bellenden Ker (N.E. du Queensland); c'est le premier représentant du sous-ordre des Craspedosomoidea dans l'Hémisphère Sud.

INTRODUCTION

Abundantly represented in all the temperate regions of the Northern Hemisphere, the order Craspedosomida (= Chordeumida *auctorum*) is rare south of the equator. Till now, it had only been reported in Chili (*Eudigona* and *Apodigona*), New Zealand (*Schedotrigona*) and Indonesia and New Guinea (families Heterochordeumidae and Metopidiorhacidae). Unknown in Africa and Madagascar, it was considered absent from Australia until Jeekel (1981) collected some specimens in New South Wales and Tasmania in 1980.

Material deposited in the Queensland Museum (QM) contains Craspedosomids collected in 1970 by H. Williams in SE Queensland (Mt Glorious), and in 1975 by R. Monroe and V. Davies north of Cairns (NE Queensland). In 1980, at about the same time as Jeekel, R. Raven also collected specimens in the Coffs Harbour area (New South Wales) and a year later, Peter M. Johns of Christchurch, investigating soil fauna in the Bellenden Ker Range (NE Queensland), collected more abundant material. The whole of this

material (except for Jeekel's, which has been treated by Golovatch (in press)) will be examined here. Three new genera have been observed, two belonging to the suborder Chordeumidea and the third to the Craspedosomidea. Some material has been deposited in the Muséum National d'Histoire Naturelle de Paris (MNHN).

Suborder CHORDEUMIDEA

The existence of the suborder Chordeumidea (with the eighth pair of legs reduced and ninth gonopods), as distinct from Craspedosomidea (with the eighth pair of legs gonopods) (regrouping all the other Craspedosomids) is not acknowledged by contemporary authors. It is true that it is no longer possible to oppose Chordeumidea and Craspedosomidea in a Manichean fashion. The mode of sperm transfer and the respective role of the copulatory legs is not known in the base majority of cases and, concerning the relative degree of complexity of the eighth and ninth pairs of legs of males, examples of intermediate structures are numerous, even in the fauna of France, the country where this hypothesis of

Craspedosomid dualism originated (Brölemann 1935). I shall maintain this division here however, even if it has lost the dualistic character it originally possessed, since when only taken as a working hypothesis it emphasizes, in an obvious way, the homogeneity of the category constituted by the European Chordeumidae, the Asian Diplomaragnidae, the Indo-Australian Heterochordeumidae and Metopidiothricidae, and the American Conotyloidea (among others). I find it hard to deny this homogeneity by reducing it to convergence, for it is based on a set of gonopodal characters, thus making it less vulnerable on this count than if it had been founded on aspects of external morphology.

The number of representatives of the Chordeumidea already known in the Indo-Australian zone, on the one hand by the genus *Schedotrigona* (New Zealand), and on the other by the genera *Heterochordeuma*, *Sumatreuma*, *Metopidiothrix* and *Malayothrix* (New Guinea and Indonesia), has been increased by three new genera, two of which are described below (*Reginaterreuma* of NE Queensland and *Neocambrisoma* of New South Wales). The third, *Australeuma* (from Tasmania) is described by Golovatch (in press). Furthermore, this author has noted the presence of the genus *Schedotrigona* in Tasmania. These findings, which fill in a large geographical gap, seem to establish a link between the forms already mentioned above, and so they are grouped together in the same superfamily Heterochordeumidea.

This new arrangement, that appears further in this text, marks an important change with respect to the system presented by Mauriès, 1978. Thus, the family Schedotrigonidae was placed in a distinct superfamily of the Diplomaragnoidea, with the family Diplomaragnidae.

The aim of this work is to review current knowledge about this superfamily as well as to describe new findings.

Superfamily HETEROCHORDEUMOIDEA (Pocock, 1894)

DIAGNOSIS

Chordeumidea (eighth pair: reduced peltogonopods; ninth pair: differentiated coxoprefemer and voluminous remains of telopodite) with tenth pair modified to store sperm and produce spermatophores (broad sternite, transformed tracheal sacs, reduced telopodites).

The other superfamilies of Chordeumidea can be broken down into two groups: one containing those in which the tenth pair of legs in males is not

modified (Diplomaragnoidea, Conotyloidea, Acrochordoidea) and the other in which not only the tenth pair, but also the eleventh and seventh pairs of legs in males are modified (Chordeumoidea).

KEY TO HETEROCHORDEUMOIDA FAMILIES (Based on male sexual characters)

1. Tenth pair of legs, with reduced telopodites but with nearly unmodified sternites and coxites Heterochordeumidae (Pocock, 1894).
Tenth pair of legs, with highly modified coxites and sternites 2
2. No flagella on either the eighth or ninth pair Metopidiothricidae (Attems, 1907).
One pair of flagella on the caudal side of eighth pair of legs... Neocambrisomidae nov.
One pair of flagella at the base of ninth pair of legs (oral side) Schedotrigonidae Mauriès, 1978.

Fam. HETEROCHORDEUMIDAE (Pocock, 1894)

Our most recent information concerning this family is due to Hoffman (1963), who revised the types. The two genera *Heterochordeuma* Pocock, 1894 and *Sumatreuma* Hoffman, 1963 have very simple gonopodal structures. This aspect makes them undoubtedly the most archaic of all the Chordeumoidea, and even the placement of this family in the superfamily can be seriously questioned, since the tenth pair of legs in the male are far less specialized than in the following families.

Fam. METOPIDIOTHRICIDAE (Attems, 1907)

Known for six species separated into two poorly defined genera, *Metopidiothrix* Attems, 1907 and *Malayothrix* Verhoeff, 1929. This family had previously been found in Java, Sumatra, New Guinea, the Bismarck Archipelago (see bibliography in Mauriès, 1978) and Vietnam (Golovatch, pers. comm.). The new Australian genus described below obviously belongs to this family.

Reginaterreuma n.g.

DIAGNOSIS

Chordeumidea (eighth pair peltogonopods, ninth pair gonopods), Heterochordeumoidea (tenth pair paragonopods), Metopidiothricidae (no flagella on eighth or ninth pairs), differing from the other genera mainly in that its peltogonopods

(eighth pair of male) are reduced to a small unpaired sternal shield. On the gonopods (ninth pair), the coxal differentiations are at last bifid. Adults have 32 rings, preadults 30.

Of interest is the frequency (undoubtedly due to the favourable collecting time) of spermatophores both in males (on the tenth pair of legs) and in females. These spermatophores seem to have been made by coagulation in sacs attached to the tracheal tracts of the male tenth pair of legs. The walls of these sacs are membranous, but certain parts are sclerotized, which gives to each species a characteristic shape of spermatophore.

TYPE SPECIES

Reginaterreuma monroei n.sp.

ETYMOLOGY

Reginaterreuma, Latin for 'Queensland', and the suffix '*euma*', which has no particular meaning, but is frequently used in the suborder for the sake of uniformity with the oldest name *Chordeuma*.

Reginaterreuma monroei n.sp.

MATERIAL EXAMINED

HOLOTYPE: Australia, NE. Queensland, Mount Finlay (15°50'S/145°13'E), Nov.29–Dec.4, 1975, R. Monroe and V. Davies, 1♂ (QM S.1460).

PARATYPE: Same data as holotype, 1♀ (QM S.1461).

OTHER MATERIAL: Same area as types, Shiptons Flat (15°48'S/145°15'E), Nov.16–21, 1975, R. Monroe and V. Davies, 1♂ 1♀ 1 juvenile (QM S.1462). Same area, '12 miles Scrub', litter (15°50'S/145°19'E), 1♂ 1 juvenile (MNHN DB.33).

DESCRIPTION

Overall colour light brown, rather evenly speckled, ventrally lighter.

Head: convex head capsule, covered with short, fine setae; prominent mandibular stipes. Gnathochilarium: mentum and promentum.

Antennae with slightly clavate antennomeres, 0.8 mm long on the ♂ holotype (0.02 + 0.10 + 0.24 + 0.16 + 0.18 + 0.12 + 0.02 mm.); the length

of antennal 'club' (distal part, straight and clavate, of antenna, from the 5th antennomere on) is 6.5 times their width.

Eyes with few ocelli (9–13) arranged in five or six rows of 1–3 ocelli forming a small anteroposteriorly elongated, pigmented patch.

Collum in half circle, with 3+3 thick macrosetae arranged in a circular arc, equidistant from each other on either side, the innermost being located midway between the middle one and the middorsal groove.

Midbody rings: narrow middorsal groove; metatergal laterodorsal shoulders only slightly developed but very distinct, the posterior profile revealing two indentations inserted between the macrosetae; the latter (3+3) are long and thick, the outermost being longer than the middle one which is longer than the innermost; they are placed quite laterally, and each is equidistant from other on either side; but the distance between the innermost and the middorsal groove is three times that between it and the middle macrosetae; the three form a 160° angle.

Epiproct with a pair of dorsal macrosetae; the caudal side is almost straight and bears the usual pair of spinnerets; lateral posterior edge with two setae on each side.

Legs are slightly longer than the vertical diameter of the body (0.70 mm in the male holotype); 54 pairs in adults.

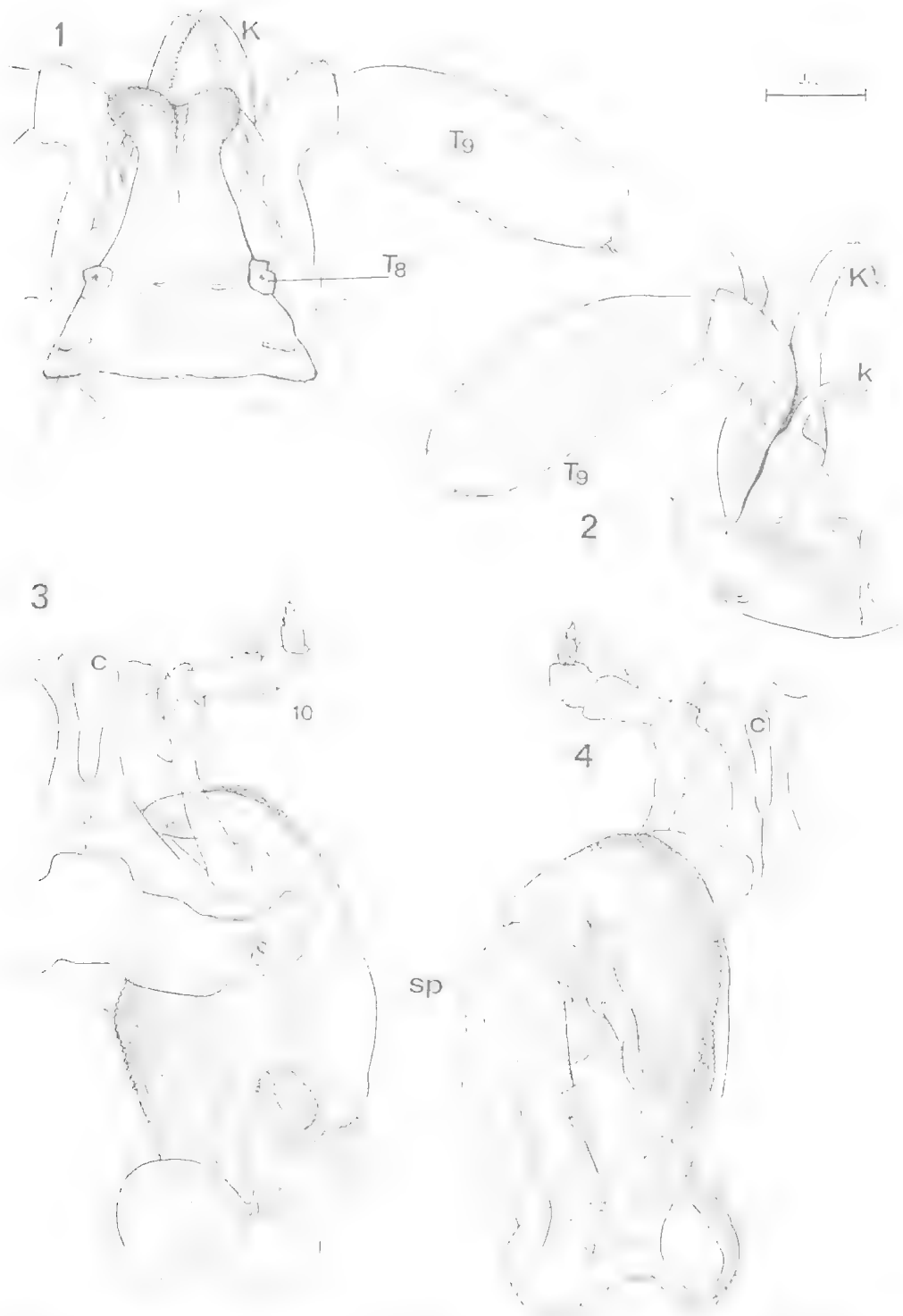
MALE SEXUAL CHARACTERS: Convex head. 44 pairs of legs posterior to the transformed legs. Nothing particular about first to seventh pairs (neither gibbosities nor processes) except that they are a bit sturdier than the other legs.

Eight pair (peltogonopods, Fig. 1) reduced to a simple unpaired shield of coxosternal origin; telopodites tiny stumps, no flagella.

Ninth pair (gonopods, Figs 1–2) like those characteristic of most Heterochordeumoidea, having a voluminous telopodite forming an incrassate oval, carried by a simple stalk (prefemur). They can be distinguished by the part

TABLE 1. *Reginaterreuma monroei*: Measurements (mm), number of rings (N) and ocelli.

	N	Length	Vertical diameter	Width	Collum width	Antenna length	Ocelli
Mt. Finlay ♂ holotype	32	7	0.60	0.80	0.45	0.80	11(1.2.3.3.2)
Mt. Finlay ♀ paratype	32	8	0.70	0.85	0.50	0.80	11(1.2.2.3.2.1)
Shiptons Flat ♂	32	7.5	0.65	0.85	0.50	0.85	12(1.2.3.2.3.1)
Shiptons Flat ♀	32	8.5	0.75	0.95	0.55	0.90	10(1.1.2.2.3.1)
12 mile Scrub ♂	32	9	0.70	0.85	0.50	0.90	13(1.2.3.3.2.2)
12 mile Scrub ♀	32	8.5	0.80	1	0.60	1	10(1.1.2.3.2.1)
12 mile Scrub ♂j.	30	5.7	0.60	0.70	0.35	0.75	9(1.2.3.2.1)



FIGS 1-4. *Reginatereuma monroei* n.g., n.sp., ♂ holotype: 1. eighth pair (peltogonopods, in foreground) and ninth pair (gonopods), oral view; 2. isolated 9th left leg, oral view; 3. tenth pair, oral view, with spermatophore in place; 4. caudal view of the same.

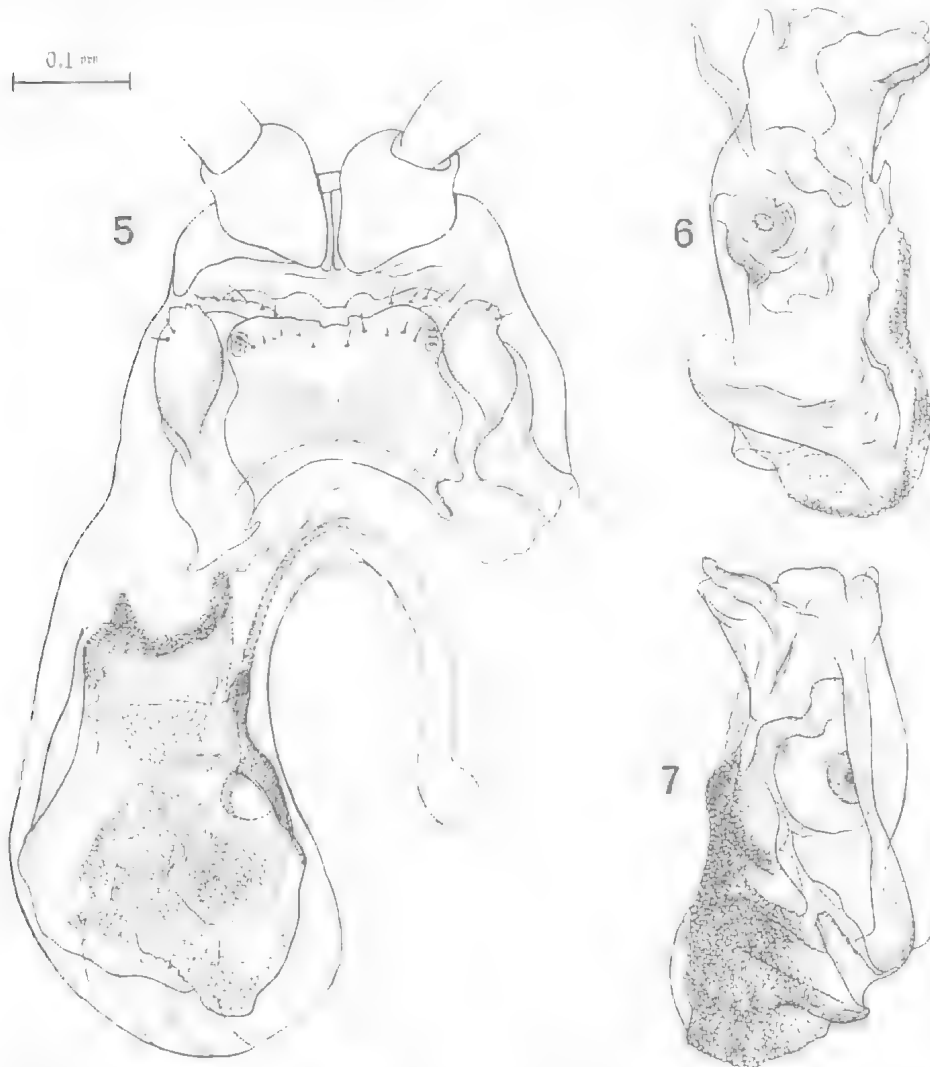
that is of coxal origin, which here is divided into two processes of unequal length; the anterior one (K) is long, with its extremity curving distad, and a posterior one (k) clearly much shorter.

Tenth pair (paragonopods, Figs 3-4) spindly four-jointed telopodites (T 10), bent between the first and second article and again between the third and fourth; the coxosternum forms mediad, a pair of horns fused at the base and diverging distally, as long as the first telopodite article. The tenth pair of legs are especially interesting because, on the caudal side, can be found a pair of ample and deep membranous sacs (sp), probably of tracheal

origin and having walls supported by a vague framework of thick sclerotized material. These pockets undoubtedly serve as a sperm receptacle and also produce a pair of spermatophores, each made of an agglomeration of coagulable substances and spermatids or spermatozooids.

Eleventh pair : no coxal glands nor any other special trait.

FEMALE SEXUAL CHARACTERS: The spermatophores mentioned above have also been found in female genital tracts. They have kept the shape they acquired in the receptacles on tenth pair of legs of the male (compare Figs 3 and 6). In the



Figs 5-7. *Reginaterreuma monroei* n.g., n.sp., - paratype: 5. base of second pair, vulvae, and spermatophores seen within the right receptacle; 6. isolated spermatophore, removed from its receptacle (mesal view); 7. the same external lateral view.

females, they have been observed placed posteriorly to the vulvae, on a level with the posterior edge of the fourth ring. Instead of being in a dilatation of the oviduct wall, they appear to be in a cul-de-sac opening between the sternite of second pair of legs and the vulvae (Fig. 5). The latter are characterized mainly by the internal valves being fused sagittally into a single posterior median unpaired plate.

ETYMOLOGY

This species is named after one of the collectors.

Reginaterreuma daviesae n.sp.

MATERIAL EXAMINED

HOLOTYPE: Australia, NE. Queensland, Mount Bartle Frere, NW. Centre Peak Ridge, rainforest (sieved litter), alt. 1400–1500 m., Oct. 7 and 8, 1981, Berlese No. 358, 1♂ (QM S.1464).

PARATYPES: QM S.1465, 2♀, same data as holotype. QM S.1466, 1♂, 2♀, same locality, Nov. 7 and 8, 1981.

DESCRIPTION

Overall colour brown, with lines of whitish spots: one laterodorsal pair of lines (on the prozonite at the macrosetae level) and one lateroventral pair. Especially the head but sometimes also the collum, epiproct and paraprocts are yellow-orange. Species larger than the precedent one.

Metatergal shoulders as in *R. monroei* but with macrosetae almost in a row. The latter are equidistant from each other and distance between the innermost and the middorsal groove is 2.6 times that between the setae.

MALE SEXUAL CHARACTERS: Third to seventh pairs of legs with telopodites barely thicker than the other legs, as in *R. monroei*, but here coxal processes are found, pronounced on fifth and sixth, insignificant on seventh pairs.

Eighth pair (peltogonopods, Fig. 9) shorter and narrower than in *R. monroei* with no trace of telopodital stumps, but with a wider base. The extremity, moderately bifid and bearing several

short setae, is enlarged subdistad by an anterior transversal crest (a).

Ninth pair (gonopods, Fig. 8) chiefly distinguished by the shape of the distal part of the large coxal process (K). Here, the bend followed by a seminal (?) groove, is ornamented on the exterior (therefore distad) by a languet (g). The small coxal process (k) has a mushroom-shaped extremity.

Tenth pair (paragonopods, Figs 10–11) as in *R. monroei* but with a very elongated prefemur and the stumpy telopodal remains. Spermatophore receptacles much shorter than in *R. monroei*.

Eleventh-thirteenth pairs of legs with ventral extensions on coxites, slight on eleventh pair, fairly long and wide on twelfth, fairly long and narrow on thirteenth.

FEMALE SEXUAL CHARACTERS: Vulvae (Fig. 13) fairly similar to those in *R. monroei* but with a broader unpaired median posterior plate formed by the fusion of the internal valves of each vulva. Here the coxites of the second pair of legs have slight dorsointernal extensions. Fig. 14 shows a spermatophore taken from the genital tract of a female: it differs from those observed in *R. monroei* in its general shape and the smaller surface of the granular zone where the sexual cells seem to be concentrated (compare with Fig. 3 and 6).

ETYMOLOGY

Species cordially dedicated to Valerie Davies, past Curator of Arachnids at the Queensland Museum.

Reginaterreuma unicolor n.sp.

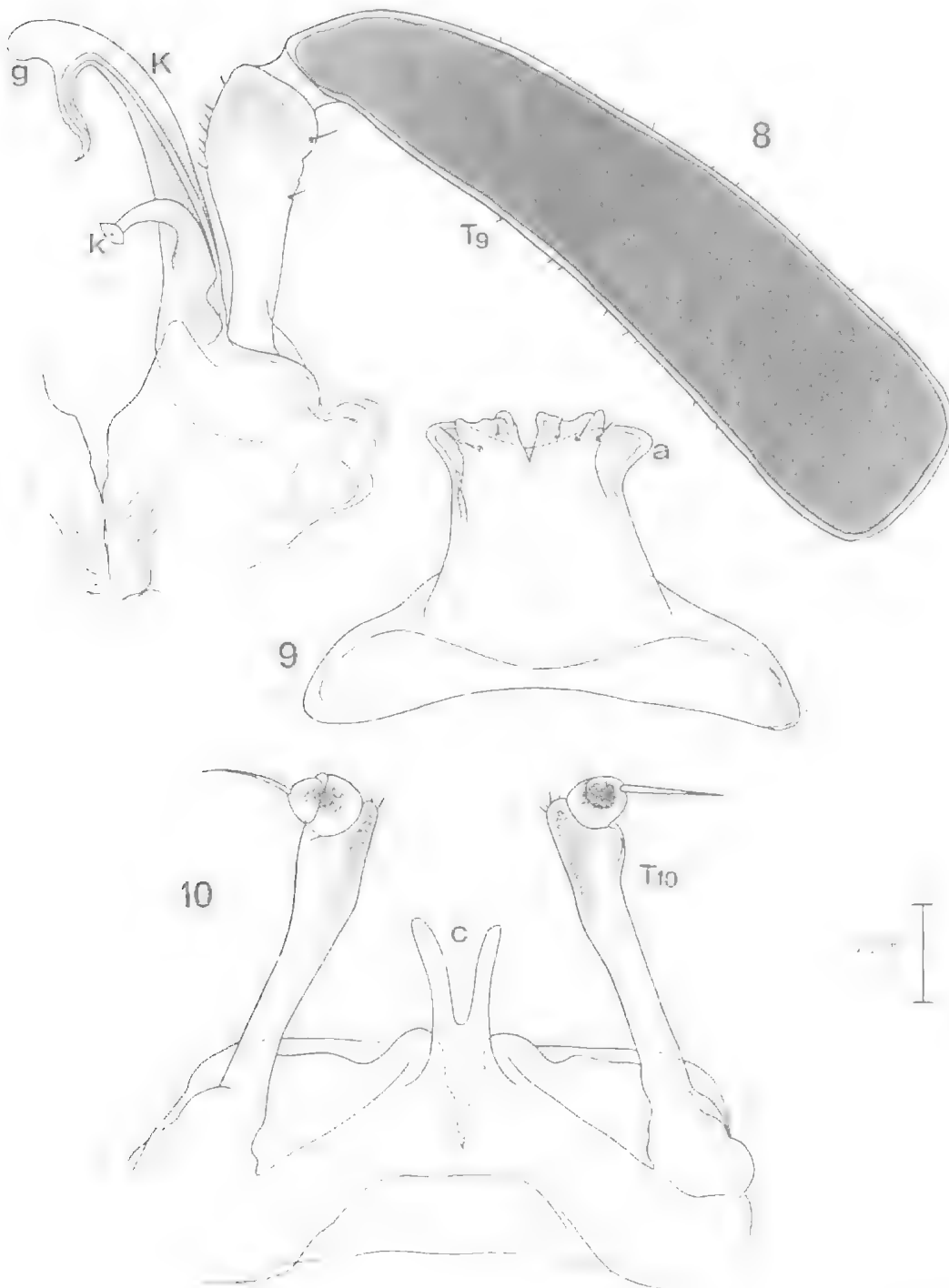
MATERIAL EXAMINED

HOLOTYPE: Australia, NE. Queensland, Bellenden Ker Range, Westgid Creek (North Branch), alt. 100 m., Berlese No. 351 (sieved litter), Nov. 1, 1981, 1♂ (QM S.1467).

PARATYPES: Same data as holotype, 1♂ 2♀ 3♂j. (QM S.1468), 1♂ 1♀ paratypes (MNHN DB 33). Same locality, same data, 1♂j., 1♀ (QM S.1470), Berlese No. 353.

TABLE 2. *Reginaterreuma daviesae*: Measurements (mm), number of rings (N) and ocelli.

	N	Length	Vertical diameter	Width	Ocelli
♂ holotype	32	8	1	1.2	18(1.2.3.4.4.4)
♂ paratype	32	9	0.8	1	18(1.2.3.4.4.4)
♀ paratype	32	10	1.2	1.4	19(2.3.4.5.5)
♂ paratype	32	10.5	1.2	1.4	22(1.2.3.3.4.4.5)
♀ paratype	32	10.5	1	1.2	19(1.2.3.4.4.5)
♂ paratype	32	11.5	1.1	1.4	19(1.2.3.4.5.4)



FIGS 8-10. *Reginaterreuma daviesae* n.g., n.sp., ♂ holotype: 8. isolated ninth left leg, oral view; 9. eighth pair, caudal view; 10. tenth pair, oral view (telopodites and sternite).

OTHER MATERIAL: Same area, Bellenden Ker Range, Cableway Base Station, alt. 100 m., Oct. 17-24, 1981, 2♂ 2♀ (QM S.1471). Same locality, Berlese No. 306, 1♂ 2j. (QM S.1472). Same area, Hilltop 5.5 km north of Mount Lewis, alt. 1200 m., Berlese No. 299, Sept. 13, 1981, G. Monteith and D. Cook, 1♂ (QM S.1473).

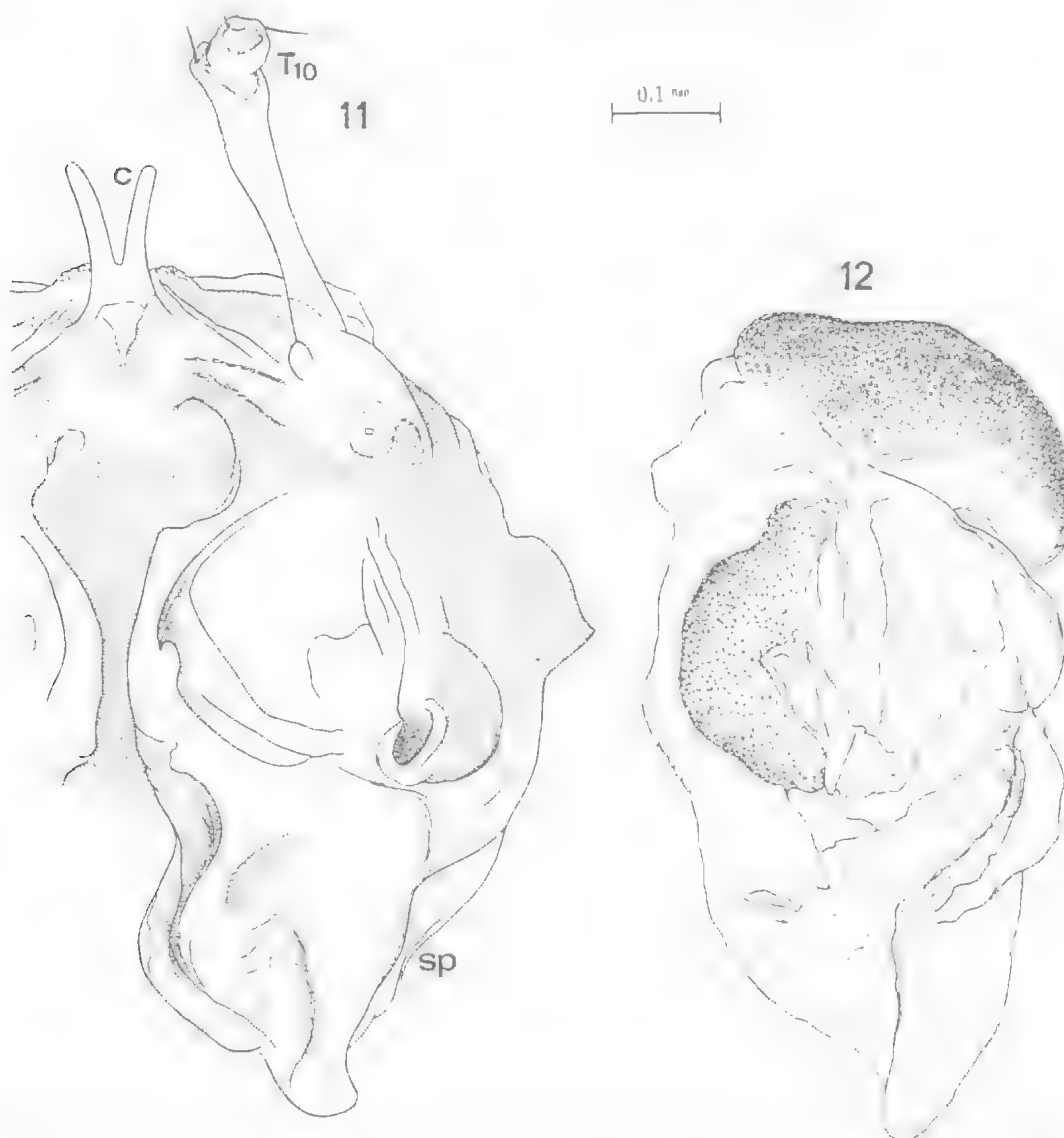
DESCRIPTION

A more or less mottled brownish color all over, often with lighter laterodorsal and lateroventral spots as in *R. daviesae*, but here the head, epiprocts and paraprocts are brown.

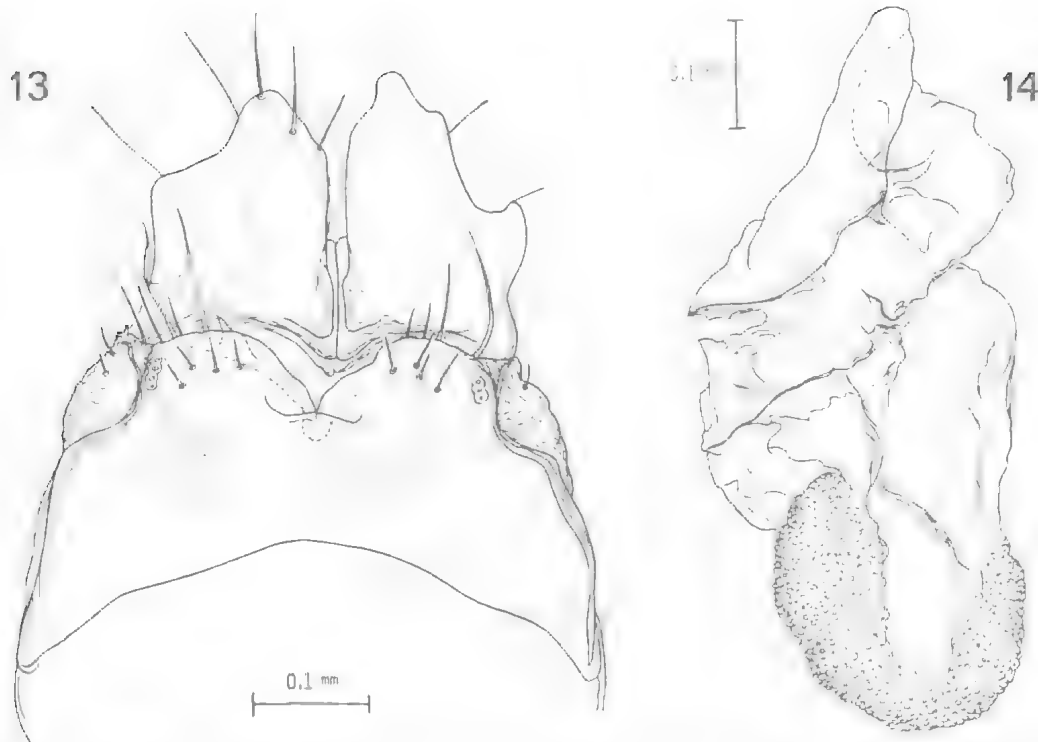
The two young females collected (Berlese No. 306) have 15 rings 16 legpairs and 3(1,2) ocelli.

MALE SEXUAL CHARACTERS: First-seventh pairs of legs have no modifications, not even in the coxites.

Eight pair (peltogonopods, Fig. 15) platelike, very similar to those of *R. daviesae*; anterior concavity bordered distad by two short divergent arms (a = homologous to the transversal crest of *R. monroei*); the extremity forms two elongated parasagittal lobes that fit in between the prefemurs of the ninth pair (gonopods).



FIGS 11-12. *Reginaterreuma daviesae* n.g., n.sp., ♂ holotype: 11. tenth pair with spermatophore (right side) in its place in sac, oral view; 12. spermatophore removed from sac on the tenth pair, seen from internal side.



FIGS 13-14. *Reginaterreuma daviesae* n.g., n.sp., ♂ paratype: 13, base of second pair and vulvae, caudal view; 14, spermatophore removed from extravulvar receptacle, seen from internal side.

TABLE 3. *Reginaterreuma unicolor*: Measurements (mm), number of rings (N) and ocelli.

	N	Length	Vertical diameter	Width	Ocelli
Loc. tip. ♂ holotype	32	10	0.80	1.10	17(1.2.3.4.4.3)
♂ paratype	32	7.5	0.80	1.10	16(1.2.3.4.3.3)
♂ paratype	32	7	0.70	0.95	14(1.2.3.4.3.1)
♂ paratype	32	9	1	1.30	17(1.2.3.3.4.4)
♂ paratype	32	10.3	1	1.30	17(1.2.3.4.4.3)
♂ paratype	32	9	0.80	1.10	17(1.2.3.4.4.3)
♂ j. paratype	30	7	0.70	0.95	14(1.2.3.4.4)
♂ j. paratype	30	7	0.75	1	14(1.2.3.4.4)
Berl. 353 ♂ j. paratype	30	5.5	0.70	0.85	12(1.2.3.3.2.1)

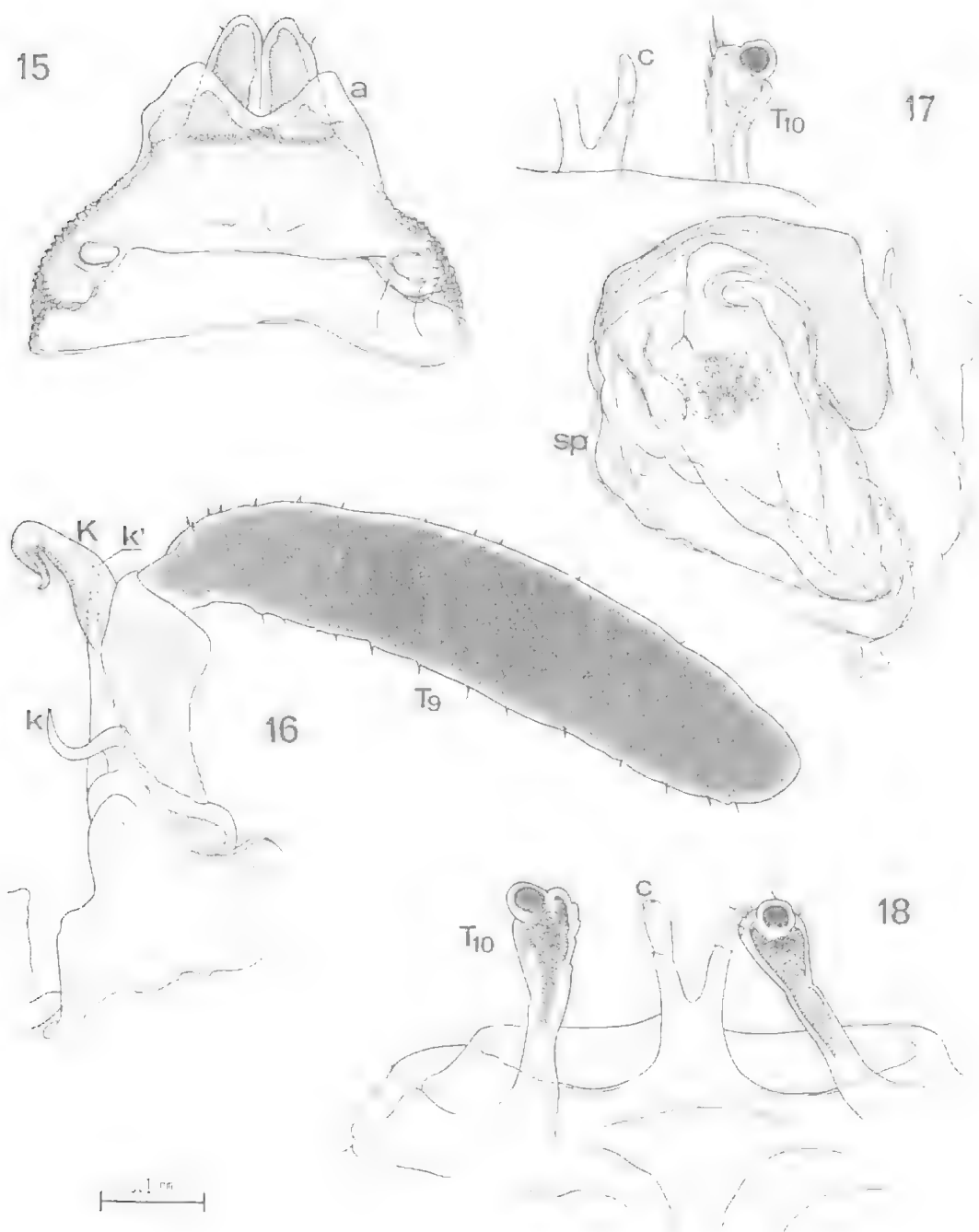
Ninth pair (gonopods, Fig. 16): distal segment of the telopodite longer than in *R. monroei*. The coxal process (K) bears an accessory branch (k') on its posterior side.

Tenth pair (paragonopods, Figs 17-18) with telopodites reduced to a slender prefemur (which is slightly clavate distad) bearing a vestigial bud on its extremity. Coxal horns of slight length. No spermatophore has been observed in this species.

Eleventh pair: coxites without coxal sacs and with a distal projection covered with a tuft of long,

thick hairs. The coxites of the more posterior legs have large, straight, unprotruding distal edges.

PRE-ADULT MALE CHARACTERS: Figs 19-21 represent the eighth, ninth and tenth pairs of legs of the only preadult male collected. He has 30 rings and 48 leg pairs. The eighth pair is practically reduced to sternites; on the ninth, the coxites show no differentiation; on the tenth, the future adult paramedian horns appear like small internal coxal laminae (k).



FIGS 15-18. *Reginaterreuma unicolor* n.g., n.sp., ♂ holotype: 15. isolated eighth pair, oral view; 16. ninth right leg, oral view; 17. 10th pair and spermatophore, caudal view; 18. tenth pair, oral view.

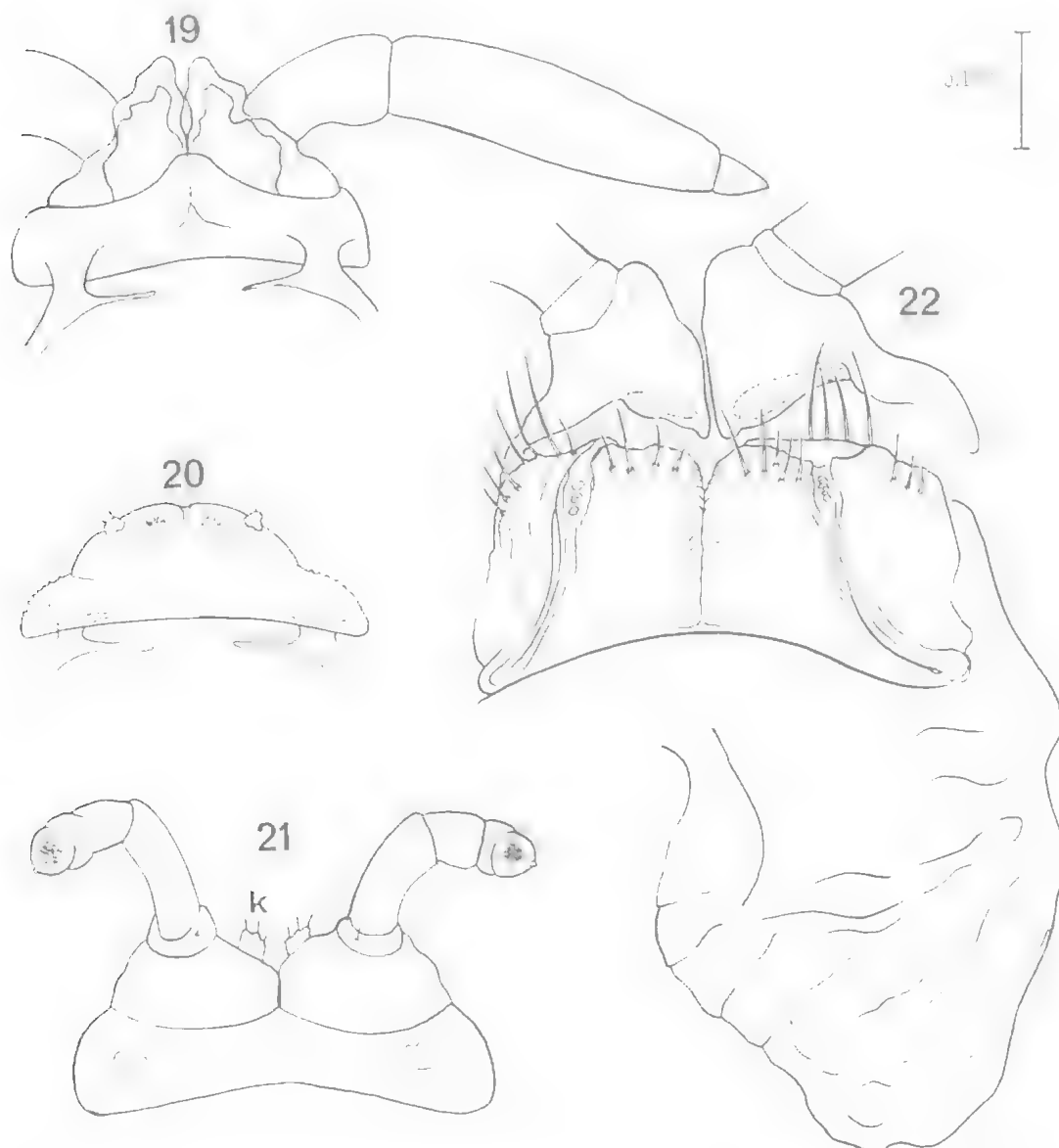
FEMALE SEXUAL CHARACTERS: Vulvae (Fig. 22) closely resemble those of the other species; but the sagittal welding of the internal valves is less obvious and the median posterior plate is narrower than that of *R. daviesae*, although the coxites of the second pair are similar to those of the latter species.

***Reginaterreuma major* n.sp.**

MATERIAL EXAMINED

HOLOTYPE: Australia, NE. Queensland, Bellenden Ker Range, summit, TV Station, alt. 1560 m., Oct. 23–31, 1981. 1♂ (QM S.1474).

PARATYPES: Same data as holotype, 2♂ 10♀ (QM S.1475), 1♂ 1♀ (MNHN, DB 33). Same locality,



FIGS 19–22. *Reginaterreuma unicolor* n.g., n.sp., preadult ♂ and ♀ paratype: 19. ninth pair of preadult ♂; 20. eighth pair of the same; 21. tenth pair of the same; 22. base of second pair, vulvae (oral view) and right receptacle of a female paratype.

rainforest, sieved litter, Nov. 1-7, 1981, Berlese No. 338, 2♂ 2♀ 1j. (QM S.1476). Same loc., same date, Berlese No. 335 (QM S.1477) 1♀. Same loc., same date, rainforest, stick brushings, Berlese No. 342, 1♀ (QM S.1478).

DESCRIPTION

As shown by the measurements (Table 4) this species is the largest of the four. Both its habitus and colouration are similar to those of the others. It is brownish, darker than the other species, with clearly distinct whitish lateroventral and laterodorsal stripes; the head is orange-yellow, like that of *R. daviesae*, but the epiproct is brown and the paraproct white.

The position of macrosetae and the shape of the metatergal shoulders are like those of *daviesae*.

MALE SEXUAL CHARACTERS: Third-seventh pairs are a bit sturdier than the other leg pairs.

Eighth pair (peltogonopods, Fig. 23), resemble those of *monroei*, but are different in that they have a transverse ridge located just above the middle oral side (a). This ridge is also found in *R. daviesae* and *R. unicolor*, but its position and shape are different.

Ninth pairs (gonopods, Fig. 23) almost identical to those of *monroei*. There is only a difference in the shape of the short posterior coxal branch (k), whose distal half narrows sharply.

Tenth pair (paragonopods, Figs 24-25) with four-segmented weak telopodites, the first segment of which is longer than the other three. Slender paramedian coxosternal horns. Wide spermatophore receptacle sacs like those in *R. daviesae*.

Eleventh-thirteenth pairs as in *R. unicolor*.

FEMALE SEXUAL CHARACTERS: In their general appearance, the vulvae (Fig. 26) are very similar

to those in *unicolor*, but here there is not visible trace of the sagittal welding of the unpaired plate (formed by the union of both internal valves). Worth noting is the existence, under the cul-de-sac formed by the receptacle, of a glandular formation (g) that seems to be connected to the tracheal sacs of the second pair of legs by means of a sinuous groove on the oral side. Fig. 27 shows the spermatophore taken from the left side (exactly the same one that is seen in Fig. 26; here it is presented medially).

Fam. NEOCAMBRISOMIDAE nov.

DIAGNOSIS

Chordeumidea (eighth pair : peltogonopods, ninth pair gonopods), Heterochordeumidea (tenth pair paragonopods) characterized by the presence of a pair of long flagella set on the caudal side of the base of the peltogonopods.

TYPE-GENUS

Neocambrisoma n.g.

KEY TO GENERA

Eighth pair (peltogonopods) marked mediad by a thick unpaired process. Metazonites with smooth teguments *Neocambrisoma* n.g.

Eighth pair (peltogonopods) mediad lacking an unpaired process. Metazonites with rough teguments *Australeuma* Golovatch (in press).

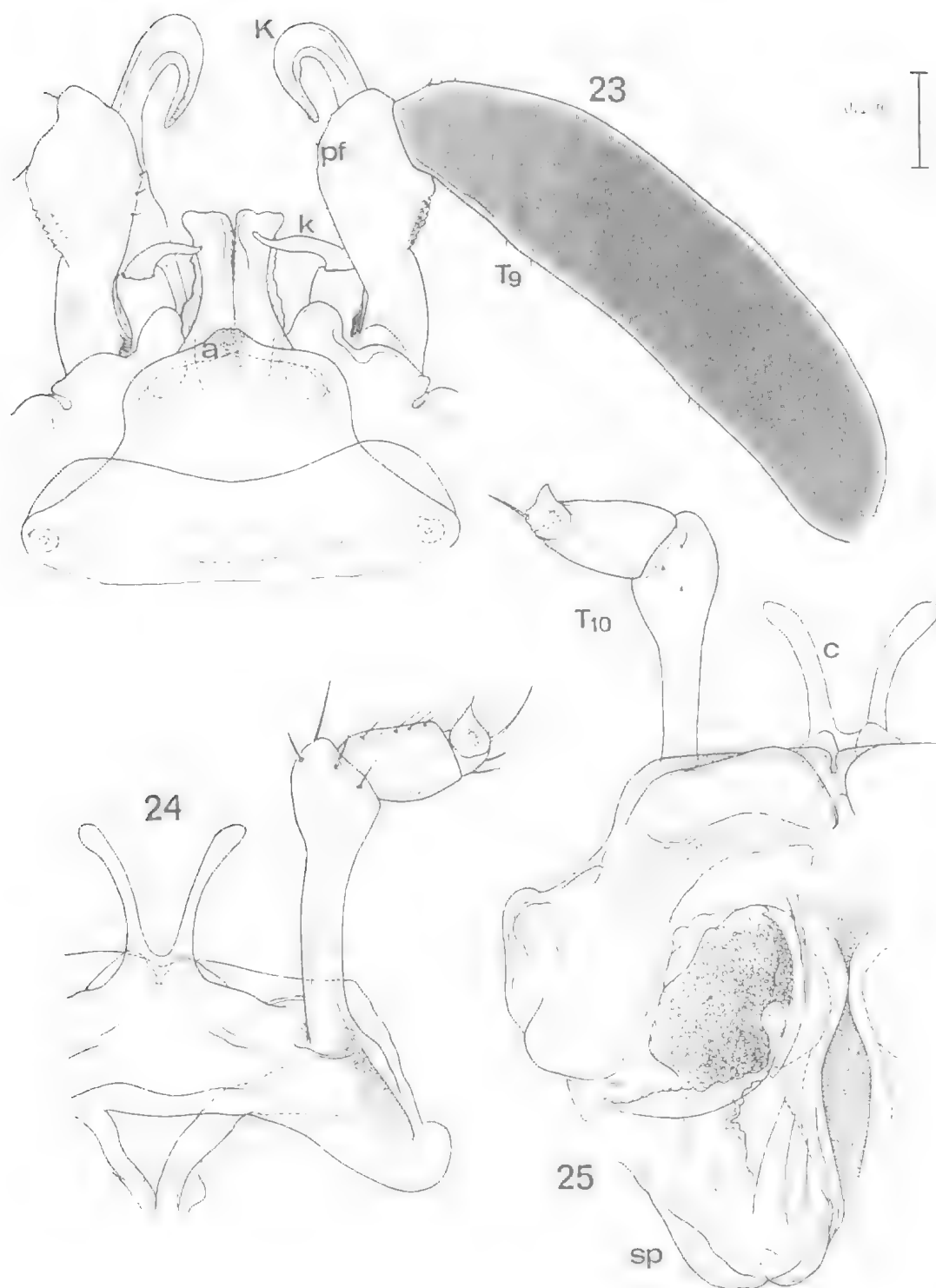
Neocambrisoma n.g.

DIAGNOSIS

Heterochordeumidea, Neocambrisomidae with the eighth pair of legs (peltogonopods) having

TABLE 4. *Reginaterreuma major*: Measurements (mm), number of rings (N) and ocelli.

	N	Length	Vertical diameter	Width	Ocelli
♂ holotype	32	13	0.9	1.3	17(1.2.3.4.4.3)
♂ paratype	32	11	0.8	—	16(1.2.2.3.4.4)
♂ paratype	32	9.5	0.8	—	19(1.2.3.4.5.4)
♂ paratype	32	11	1	1.25	19(1.2.3.4.5.4)
♀ paratype	32	14	1.1	1.5	19(1.2.3.4.5.4)
♀ paratype	32	13.5	1.2	—	17(1.2.3.4.4.3)
♂ paratype	32	10.5	1.1	—	18(1.2.3.4.4.4)
♀ paratype	32	11	1.2	—	18(1.2.3.4.4.4)
♂ paratype	32	?	1.1	—	15(1.2.3.3.3.3)
♀ paratype	32	13	1.1	—	19(1.2.3.4.5.4)
♀ paratype	32	13.5	1.1	—	18(1.2.3.4.4.4)
♀ paratype	32	12	1.1	1.5	17(1.2.3.4.3.2.2)
♀ paratype	32	14	1.2	—	17(1.2.3.4.4.3)
♀ paratype	32	11	1.2	—	18(1.2.3.4.4.4)



FIGS 23-25. *Reginaterreuma major* n.g., n.sp., ♂ holotype: 23. eighth and ninth pairs, oral view; 24. tenth pair, oral view; 25. tenth pair, with right spermatophore, caudal view.

sturdy flagella and a pronounced unpaired median projection. The ninth pair of legs (gonopods) with coxal process forming a rectangular lamina. The 10th pair with telopodites that are extended but have only two to four segments (stumps in *Australeuma*). Smooth metazonites, with 3+3 thick macrosetae. 32 rings in both sexes.

TYPE-SPECIES

Neocambrisoma raveni n.sp.

ETYMOLOGY

Neocambria, Latin for New Wales, and the Greek latinized suffix *soma* : body.

Neocambrisoma raveni n.sp.

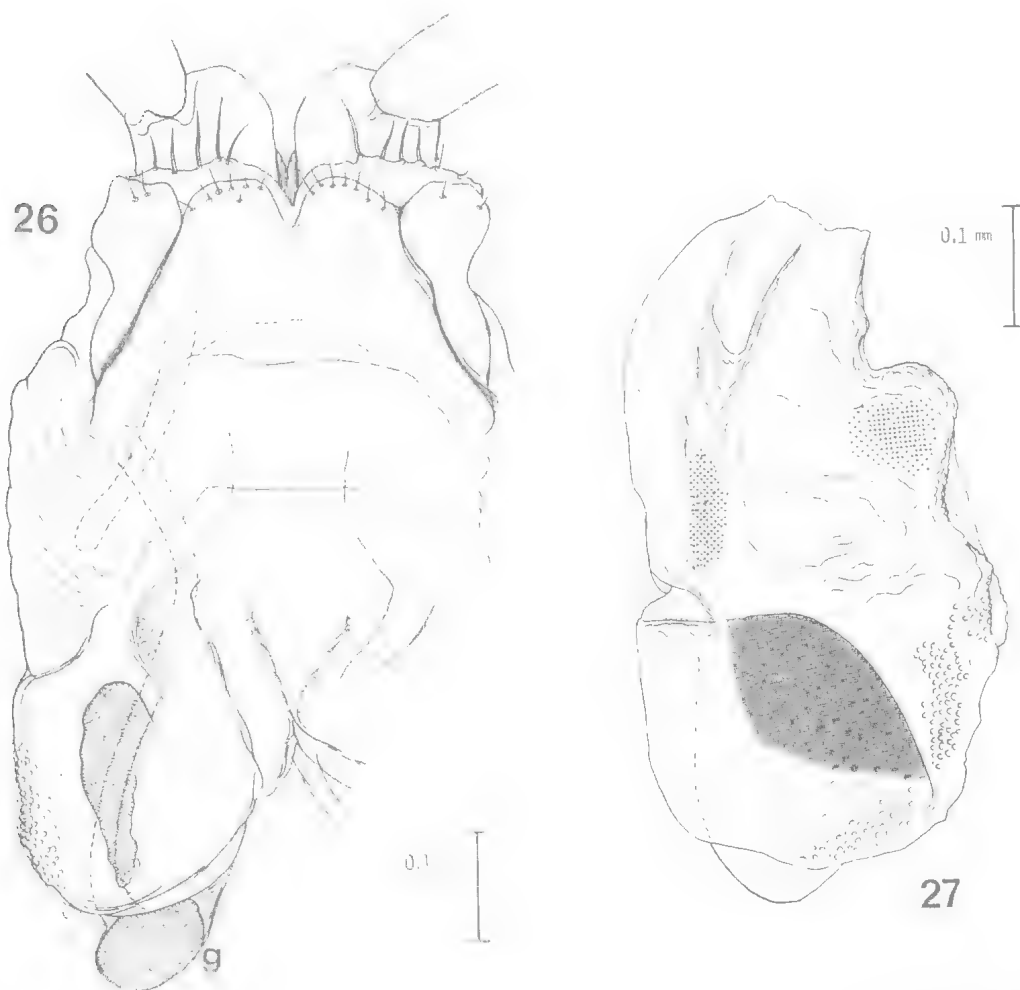
MATERIAL EXAMINED

HOLOTYPE: Australia, New South Wales, Coffs Harbour, Bruxner Forest Park, Nov. 12, 1980, R.J. Raven, 1♂ (QM S.1479).

PARATYPES: Same data as holotype, 3♂ 1♂j. 8♀ 1j. (QM S.1480); 1♂ 1♀ 1♂j. (MNHN DB 33).

DESCRIPTION

Colour: dark brown middorsal stripe between two lighter, narrow laterodorsal stripes, brown on the metazonites, whitish on the prozonites. The ventral part of the flanks is light brown on the prozonites, whitish on the metazonites. Legs are



FIGS 26-27. *Reginaterreuma major* n.g., n.sp., ♀ paratype: 26. base of second pair, vulvae (oral view) and right receptacle with spermatophore; 27. spermatophore removed from receptacle, mesal view.

light brown, growing darker distad. Epiproct is entirely dark brown (paraprocts are lighter). Head capsule and cheeks are light brown, clypeolabrum is whitish, with a yellow patch between the antennae.

Convex head capsule, densely covered with short, fine setae; prominent mandibular stipes; trident labrum; gnathochilarium (Fig. 36) with trapezoidal mentum separated from the stipes by a small triangular area. Antennae whose antennomeres, especially the most distal ones, are slightly clavate and measure 1.2 mm on the male holotype ($0.05 + 0.18 + 0.30 + 0.20 + 0.27 + 0.17 + 0.13$ mm) and 1.4 mm on the largest female. The length of the antennal 'club' is 5.5 times its width.

Eyes: few ocelli (14–17 in adults), arranged in an anteroposteriorly extended pigmented field, in six or seven (rarely eight) transversal rows of one to four ocelli (see above table).

Collum in a half circle with rounded angles; the 3 + 3 macrosetae are equidistant from each other on each side and the innermost is located exactly between the middle one and the middorsal groove.

Midbody rings: narrow, distinct middorsal groove; metatergal shoulders in a laterodorsal position, nearly forming keels and bearing three long macrosetae (0.3 mm on the male holotype), that are thick and curved slightly backwards. They are placed in a transverse line on the posterior rings but form an open angle (about 150°) on the midbody ones; on each side, they are nearly equidistant from each other and the distance separating them is half that between the innermost and the middorsal groove.

Epiproct as in *Reginaterreuma*.

The length of the legs equals the width of the body (1.1 mm in the ♂ holotype); the adult has 54 pairs (the thirtieth ring is hemiapodous, i.e. has only one pair of legs).

ADULT MALE SEXUAL CHARACTERS: Sixth and seventh pairs thicker than the others pairs. Deformed tarsus and prefemur (Fig. 28).

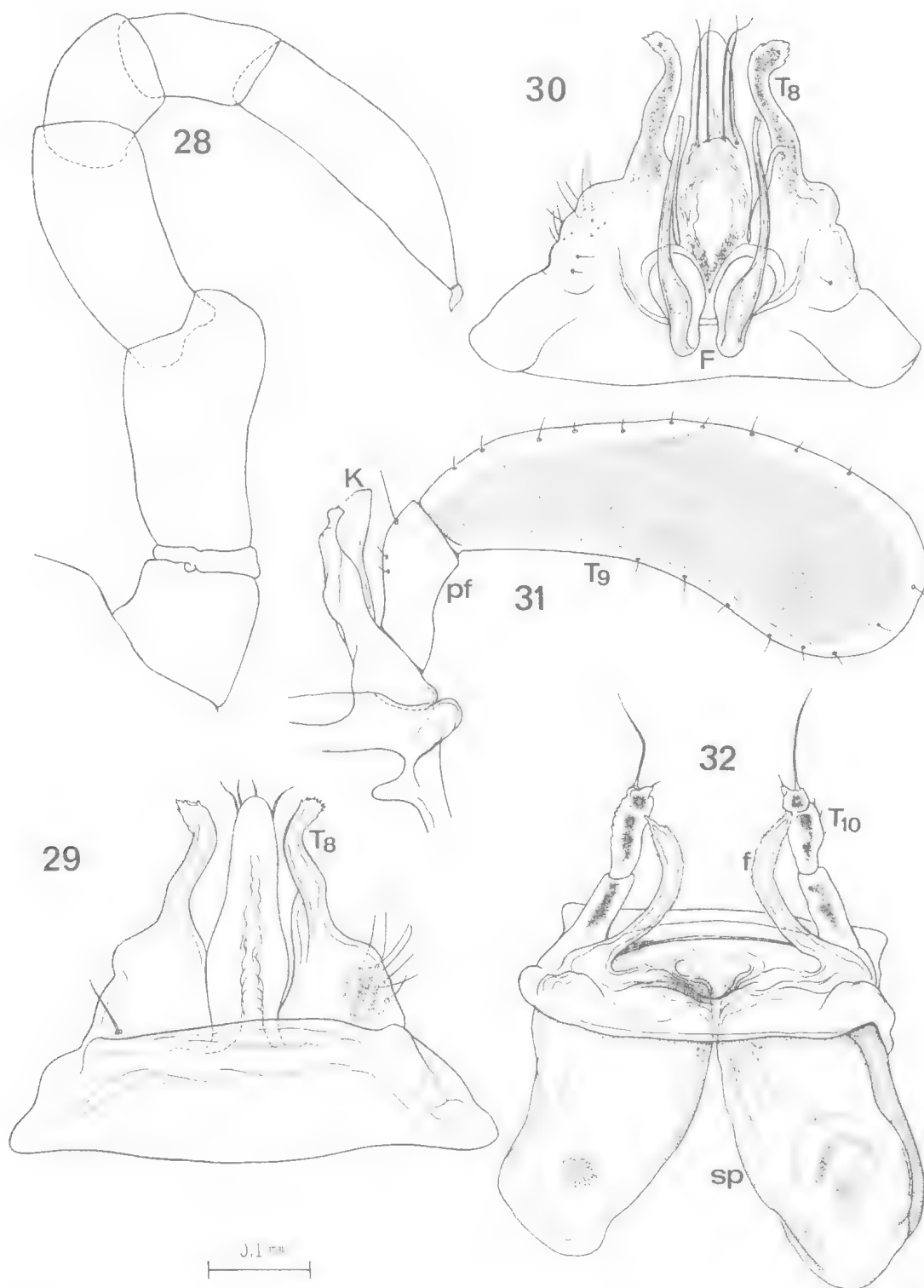
Eighth pair (peltogonopods, Figs 29–30) reduced to a sternite projected by a large unpaired median process surrounded by two vestigial telopodites (T8), but noteworthy mainly for the existence of a pair of sturdy flagella (F) on the caudal side of its sternal band. Among millipedes, flagella, similar in structure and also located on the caudal side of the eighth pair, are frequent in Iulids and Blaniulids, and exist in Cambalids, certain Craspedosomids and, in Chordeumids only in the genus *Lankasoma*.

Ninth pair (gonopods, Fig. 3) characteristic of those found in many Chordeumidea, in particular because their telopodite (T9) forms an incrassate, elongated mass attached to a simple prefemoral stem (pf). The coxal process (K) appears as a simple subrectangular lamina with its internal edge slightly thickened and without any trace of a groove or furrow as in *Reginaterreuma*.

Tenth pair (paragonopods, Fig. 32) with reduced, three-segmented telopodites (T10), each flanked on its oral side by a slightly shorter falciform process (f); two enormous sacs (sp) are invaginated in the sternite (wide rectangular band); these sacs are surrounded and supported by tracheal tracts, and as in *Reginaterreuma*, they

TABLE 5. *Neocambrisoma raveni*: Measurements (mm), number of rings (N) and ocelli.

	N	Length	Vertical diameter	Width	Ocelli
♂ holotype	32	12	0.85	1.1	17(1.2.3.3.3.2.2.1)
♂ paratype	32	13.5	0.80	–	15(1.3.3.2.3.3)
♂ paratype	32	11.5	0.80	–	14(2.2.2.3.3.2)
♀ paratype	32	10.5	0.90	–	15(1.2.3.3.3.3)
♀ paratype	32	10.8	0.80	–	17(1.3.3.3.3.4)
♀ j. paratype	30	9.5	0.75	–	12(1.2.2.2.2.3)
♀ j. paratype	30	9	0.75	0.95	12(1.2.3.2.2.2)
♂ paratype	32	11	0.90	1.20	16(1.2.3.3.3.2.2)
♂ paratype	32	11.5	0.95	1.40	16(1.2.3.3.3.2.2)
♂ paratype	32	11	1	–	15(1.2.3.3.3.2.1)
♂ paratype	32	11.7	0.80	–	15(1.2.3.3.3.2.1)
♂ paratype	32	11.7	0.80	–	14(2.3.3.3.3)
♂ paratype	32	10.8	0.90	–	16(1.2.1.3.3.3.3)
♂ paratype	32	9.7	0.75	–	15(1.2.2.2.3.3.2)
♂ paratype	32	11.5	0.70	–	15(1.2.3.3.3.3)
♂ paratype	32	10.5	0.95	–	15(1.2.3.3.3.3)
♂ j. paratype	30	8	0.70	–	13(1.2.2.2.3.3)



FIGS 28-32. *Neocambrisoma raveni* n.g., n.sp., ♂ holotype: 28. telopodite and coxite of 7th pair; 29. 8th pair, oral view; 30. same, caudal view; 31. ninth right leg, oral view; 32. tenth pair, oral view.

obviously play a part in sperm storage prior to spermatophore production.

PRE-ADULT MALE SEXUAL CHARACTERS: The young males with 30 rings have 48 leg pairs (38 pairs posterior to the paragonopods). They therefore have 3 apodous rings (including the epiproct) and one hemiapodous ring.

Eighth pair (Fig. 34) reduced to a low crescent-shaped band on which can be found buds of coxal origin (f) that will grow into the adult's flagella. Telopodite traces (t) can be recognized by the pigmentary spots, each with a tuft of setae.

Ninth pair (Fig. 33) already showing adult structure, except that the last segment of the telopodite, is less voluminous and the prefemur is shorter and sturdier. The coxite is split longitudinally along the caudal side.

Tenth pair (Fig. 35) with an unmodified sternite, coxites without coxal glands and telopodites reduced to six segments, the three most distal being clearly regressive.

FEMALE SEXUAL CHARACTERS: Fig. 37 shows the vulvae, which have no special characteristics. Extra-vulvar structures similar to those found in *Reginaterreuma* females have not been observed here.

ETYMOLOGY

Species cordially dedicated to its collector, the Curator of Arachnology at the Queensland Museum, Robert J. Raven.

Neocambrisoma sp.

MATERIAL EXAMINED

Australia, SE. Queensland, Mount Glorious; litter, Oct. 28, 1970, H. Williams, 1 ♂ juv. (QM); same area, Nov. 18, 1970, H.W., 1 ♂ (QM).

REMARKS

In all probability a new species, that will be described when the adult male is discovered.

Fam. SCHEDOTRIGONIDAE Mauriès, 1978

This monogeneric family was previously known only in New Zealand (cf. Mauriès, 1978). A new species *Schedotrigona tasmanica* Golovatch (in press) has been discovered by Jeekel in Tasmania.

Suborder CRASPEDOSOMIDEA

The Craspedosomidea are known in the temperate and certain subtropical zones of the Northern Hemisphere, but have not been previously recorded in the Southern Hemisphere. The closest records to Australia are from southern India (*Pygmeosoma*) and Japan

(*Macrochaeteuma*). It was therefore a great surprise for the author to discover a Craspedosomid in material collected from the mountains south of Cairns (Bellenden Ker Range, Bartle Frere) by Professor Peter M. Johns. It seems confined to this area and is without doubt a new genus, *Peterjohnsia*, very warmly dedicated to its discoverer.

This new genus is easily placed in the superfamily Cleidogonoidea (a large group of both Palearctic and Nearctic families) whose diagnosis and contents are still far from fixed and agreed on by the specialists (see Shear 1979; Hoffman 1979; Mauriès 1982; Mauriès & Geoffroy 1983). In light of these difficulties and on the basis, taken arbitrarily, of Shear's diagnosis of the superfamily (1979) and those of Mauriès for the family (1981), a new family was created for the new genus *Peterjohnsia*.

Superfamily CLEIDOGONOIDEA (Cook, 1896)

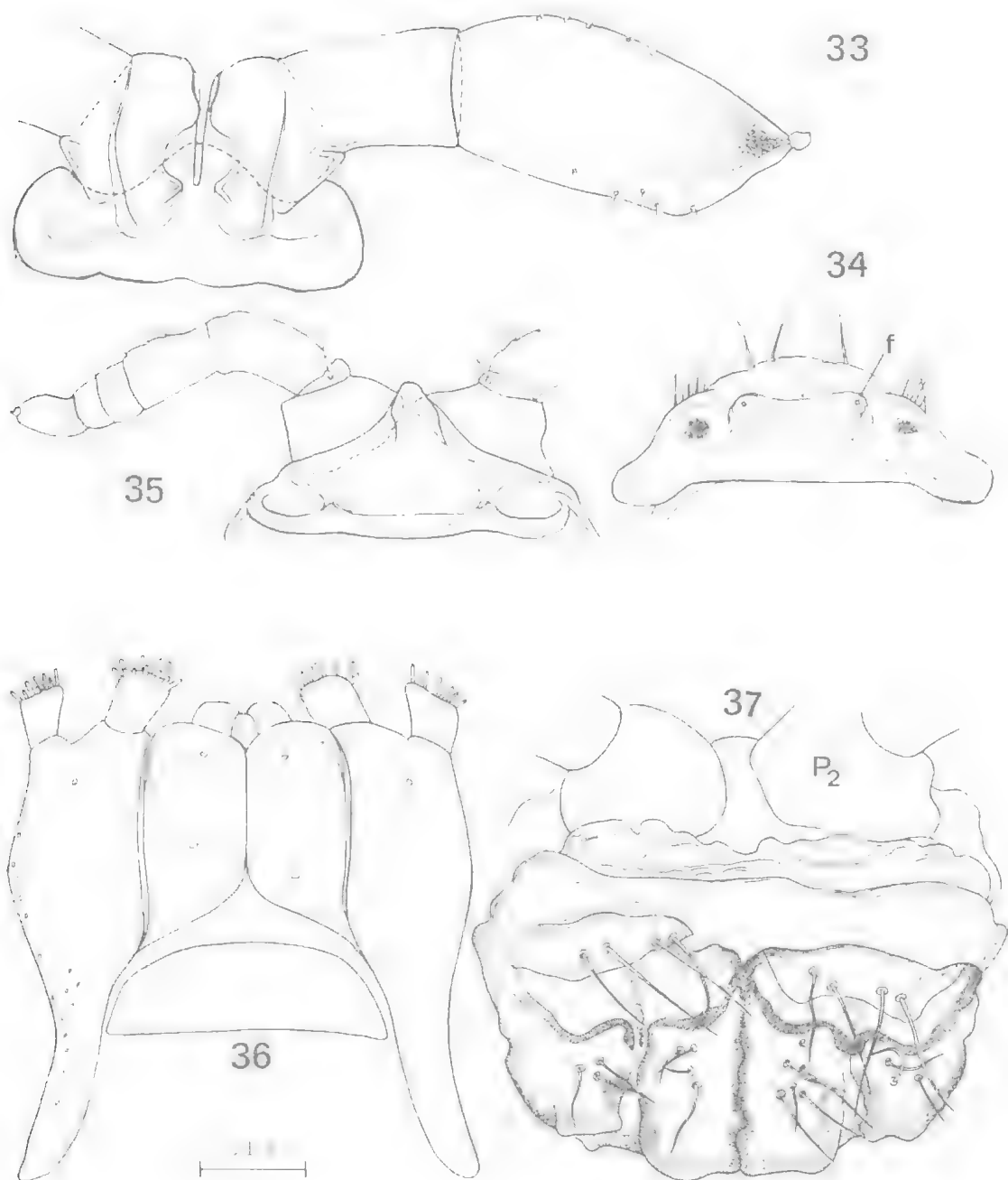
DIAGNOSIS

Eighth pair of legs of the male (gonopods), forming a block that is generally more or less transversely divided into two parts: an anterior part (sternite and angiocoxite) and a posterior part (colpocoxite and telopodite); the telopodite is always regressive (consisting of no more than a short stem or flagellum or small shield, or fused with the colpocoxite). The ninth pair of legs of the male (paragonopods) regressive usually simple. Gnathochilarium: mentum and promentum. Adults have 26-32 rings.

A list of families accompanied by their diagnoses were given by Mauriès (1982). These diagnoses are based essentially on gonopodal structures (eighth pair of legs of the male) and mainly on the relative development of three essential parts: a) telopodite, b) colpocoxite, c) angiocoxite + sternite, and on the telopodite's shape, position and degree of autonomy. The aim of the succinct key below, which uses these characteristics, is to place this new family in relation to the others:

KEY TO CLEIDOGONOIDEA FAMILIES

1. Eighth pairs of legs of the male: telopodite more or less fused with the colpocoxite making it difficult or impossible to distinguish.....
.....Families Anthogonidae, Cleidogonidae, Rhiscosomididae, Tingupidae, Trichopetalidae.
- Eighth pair: telopodite forming a flagellum, short stem, small plate or stump 2
2. Eighth pair: telopodite forming a flagellum or short stem, set laterally but inside the gonopodal



FIGS 33–37. *Neocambrisoma raveni* n.g., n.sp., preadult ♂ and ♀, paratypes: 33. ninth pair of preadult male, caudal view; 34. eighth pair of the same; 35. tenth pair of the same; 36. gnathochilarium of a ♀ paratype; 37. base of second pair and vulvae of the same

block between the anterior and posterior parts and therefore often hidden

..... Families Brachychaeteumidae, Macrochaeteumidae, ?Niponiosomidae.

Eighth pair : telopodite a short stem, small shield or stump set outside the gonopodial block and therefore visible..... 3

3. Eighth pair : telopodite forming a short stem..
..... Families Branneriidae, Chamaesomidae, Kashmireumidae.

Eighth pair : telopodite forming a stump or small subrectangular shield, bearing several setae distad

..... Family Peterjohnsiidae nov., for the single genus *Peterjohnsia*.

Peterjohnsia n.g.

DIAGNOSIS

Eighth pair of legs of the male (gonopods) with telopodites quite distinct from the colpocoxites, forming a subrectangular lamella not as wide as it is long, setigerous distad; colpocoxites forming elongated laminae clearly separated from each other by a large unpaired median process of the sternite. Ninth pair of legs of the male (paragonopods) with sternites forming a wide concave rectangular plate anteriorly, bearing telopodites similar to those on the gonopods. 30 rings in males, 32 in females. Rough teguments. Small soil forms (maximum length 6 mm).

TYPE-SPECIES

Peterjohnsia basimontana n.sp.

Peterjohnsia basimontana n.sp.

MATERIAL EXAMINED

HOLOTYPE: Australia, NE. Queensland, Bellenden Ker Range, Cableway base, alt. 100 m., Oct. 17–24, 1981, 1 ♂ (QM S.1481).

PARATYPE: Same data as holotype, 7 ♂ 2 ♀ j 9: and j. (QM S.1482); 2 ♂ 2: (MNHN, DA 213).

OTHER MATERIAL: Same area, Bellenden Ker Range, 1 km. south of Cable Tower 6, Oct. 17–24, 1981, alt. 500 m., Berlese No. 310, 1 ♂ 1j. (QM S.1483); same locality, same date, Berlese No. 314, 1 ♂ 1: (QM S.1484); Berlese No. 317 1 ♂ j. 1 ♂ 1: (QM S.1485); Berlese No. 319, 3: 1j. (QM S.1486); Berlese No. 320, 1 ♂ j. 2: j. (QM S.1487); same area, 1/2 km. south of Cable Tower 7, alt. 500 m., Nov. 3–5, 1981, 1 ♂ 1: (QM S.1488).

DESCRIPTION

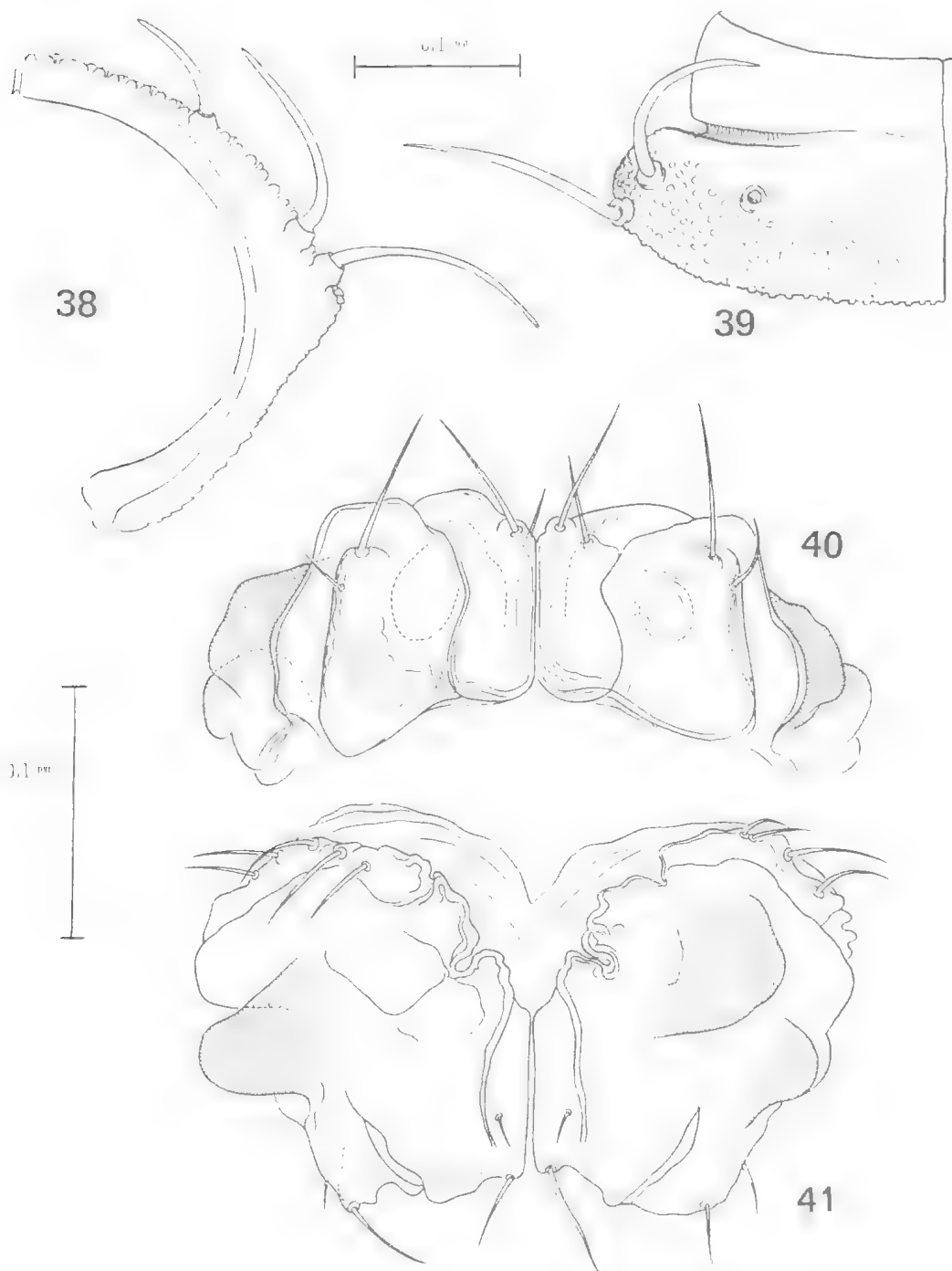
Overall colour brownish, more or less speckled, except for a white fusiform middorsal stripe that is fairly wide but narrows progressively anteriorly and posteriorly.

It should be noted that the length of certain individuals (values in parentheses in the Table 6) is exaggerated because of poor fixation.

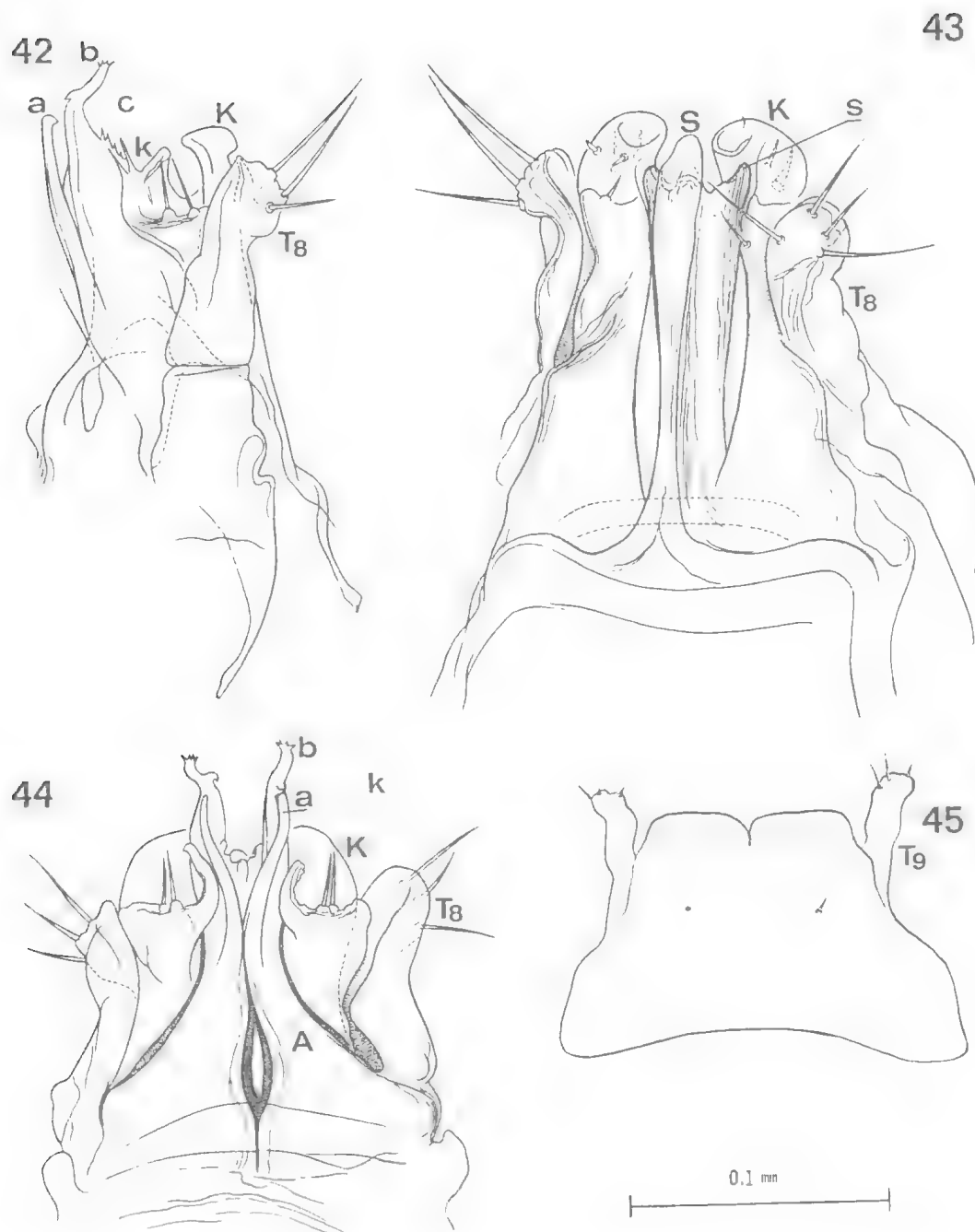
The number of rings (32) and of leg pairs (54) indicate that adult females have two apodous rings (including the epiproct) and one hemiapodous. Males, like preadult females, have 48 leg pairs, of which three are apodous (including the epiproct).

TABLE 6. *Peterjohnsia basimontana*: Measurements (mm), number of rings (N), leg pairs (lp) and ocelli.

	N	lp	Length	Vertical diameter	Width	Ocelli
♂ holotype	30	48	3	0.30	0.34	10(1.2.3.3.1)
♂ paratype	30	48	4.6	0.33	0.37	10(1.2.3.3.1)
♂ paratype	30	48	4	0.25	0.28	10(1.2.4.3)
♂ paratype	30	48	3	0.29	0.34	9(1.2.3.3)
♂ paratype	30	48	3.7	0.30	0.34	?
♂ paratype	30	48	3.6	0.36	0.40	10(1.2.3.3.1)
♂ paratype	30	48	3	0.36	0.40	9(1.2.3.3)
♂ paratype	30	48	4.6	0.36	0.40	11(1.2.3.3.2)
♂ j. (A-1)	27	40	2.25	0.25	0.28	8(1.2.3.2)
♂ j. (A-1)	27	40	2.90	0.30	0.34	9(1.2.3.3.2)
♀ paratype	32	54	(6.5)	0.46	0.52	11(1.2.3.3.2)
♀ paratype	32	54	4.8	0.40	0.45	11(1.2.3.3.2)
♀ paratype	32	54	(7.1)	0.45	0.51	11(1.2.3.3.2)
♀ paratype	32	54	5.7	0.40	0.45	11(1.2.3.3.2)
♀ paratype	32	54	(7.1)	0.46	0.52	12(1.2.3.3.3)
♀ paratype	32	54	(6.1)	0.38	0.43	11(1.2.3.3.2)
♀ paratype	32	54	4.6	0.44	0.50	11(1.2.3.3.2)
♀ paratype	32	54	(7.3)	0.46	0.52	12(1.2.3.3.3)
♂ j. (A-1)	30	48	3.4	0.35	0.40	10(1.2.3.3.1)
♀ j. (A-2)	27	40	(4.4)	0.31	0.35	8(1.2.3.2)
♂ j. (A-3)	23	32	3	0.25	0.28	7(1.2.3.1)



FIGS 38-41. *Peterjohnsia basimontana* n.g., n.sp., : paratype: 38. oral view of the left half of the midbody ring; 39. dorsal view of the same; 40. vulvae, caudal view; 41. the same, distal view.



FIGS 42–45. *Peterjohnsia basimontana* n.g., n.sp., ♂ holotype: 42. eighth pair (gonopods), lateral view; 43. the same, oral view; 44. same, caudal view; 45. isolated ninth pair (paragonopods), caudal view.

and one hemiapodous. Young female with 27 rings, at stage A(adult)-2, like preadult males (at stage A-1), have 40 leg pairs, apodous rings (including the epiproct) and on hemiapodous. I was able to observe eight pairs of podous buds on this young female, which clearly indicates that it belongs to the stage preceding the preadult one (A-2). The only young female with 23 rings had 32 leg pairs (and 8 pairs of podous buds!) and therefore 4 apodous rings (including the epiproct) and one hemiapodous ring, thus putting her at the A-3 stage.

Short head capsule, with convex hairy face. Short, sturdy antennae (their length is equal to the width of an average metazonite); the length of the antennal club is 3 to 3.5 times longer than its width. The eyes are made up of a small number of pigmented ocelli (9-12 in adults) arranged in a longitudinally elongated oval patch. Gnathochilarium with divided mentum (triangular promentum; trapezoidal mentum); external palpus of the stipes is elongated (its length is 2.5 times its width) and is oblique and bears five spinnerets; the internal palpus is sturdy and enlarged distad, not quite as long as wide, with 8-10 spinnerets in its apical region. 12-combed mandibles.

Midbody rings: The surface of the metatergites is rough and granular. This aspect is not caused by small scales as in *Chamaesoma*, *Xystrosoma* or *Tingupa*, but is due to tiny hemispherical or truncated protuberances vaguely lined in ten or so transversal rows (Fig. 39). Each row contains about 30 granules on each side of the middorsal groove. Here and there, about every three to five granules is inserted a minute seta of the same length as the granules. The 3 + 3 macrosetae are long and thick (their length reaches 2/5 the width of the metazonites); the two outermost stick far out to the side while the innermost is a bit nearer to the middle one than to the middorsal groove. The metatergal shoulder is poorly developed and located midway up the flanks (Fig. 38).

Epiproct common, with a dorsal macroseta and two setae on either side.

Short legs, length less than the prozonite diameter.

MALE SEXUAL CHARACTERS: Nothing special about the legs located before and after the gonopod and paragonopods; no coxal glands on 10th and 11th pairs.

Eighth pair (gonopods, Figs 42-44) formed on either side and behind of a long median stalk sprouting from the oral transversal sternal band. This stalk gets progressively larger and forms, subdistad, a laterodistal angle on each side (s) and

middistad, a club-like structure (S). Angiocoxites (A) set posteriorly, not fused sagittally, growing progressively thinner from the base to the summit and becoming bifid halfway up: a short branch (a) in the caudal position and a long one (b) further forward; the latter's anterior profile is denticulated (c). Colpocoxites (K) forming two plates separated both by the sternal projection and the angiocoxites; their distal profile is regularly rounded, their oral side scattered with several small setae, their caudal side marked by a heavy subdistal transversal crest bearing two thick setae and extended on the internal distal side by a small leaf (k) whose edge, when viewed laterally (Fig. 42), appears to be partially cut into spines. Finally the telopodites look exteriorly like subrectangular plates with rounded distal edges and three or four long and sturdy setae.

Ninth pair (paragonopods, Fig. 45) reduced to a large subtrapezoidal sternite flanked by stumps (telopodites, T9) like those on the gonopod.

FEMALE SEXUAL CHARACTERS: The vulvae (Figs 40-41) are not fused sagittally by their internal valves. These are much shorter than the external ones, which are marked by voluminous refringent protuberances. Low opercule, bordered by 4-5 long setae.

Peterjohnsia summa n.sp.

MATERIAL EXAMINED

HOLOTYPE: Australia, NE. Queensland, Bellenden Ker Range, summit TV station, litter, Berlese No. 336, alt. 1560 m, Nov. 1-7, 1981, 1 ♂ (QM S.1489).

PARATYPES: Same data as holotype, 5 ♀ and 3 ♂ (QM S.1490). Same locality, same date, Berlese No. 337, 3 ♀ 2 ♂ (QM S.1491); Same locality, same date, Berlese No. 338, 1 ♀ 3 ♂ (QM S.1492); Same locality, same date, Berlese No. 335, 1 ♀ (QM S.1493); Same locality, same date, Pyrethrum, on rainforest foliage, 1 ♀ (S.1494); Same locality, Oct. 25-31, 1981, 2 ♀ j. 7 ♂ 6 ♂ j. (QM S.1495) and 2 ♀ 3 ♂ j. (MNH, DA 213).

OTHER MATERIAL: Same area, Mount Bartle Frere, NW Center Peak Ridge, alt. 1400-1500 m., Berlese No. 358, Oct. 7-8, 1981, 1 ♀ 7 ♂ (QM S.1496); Mount Bartle Frere, South Peak summit, alt. 1620 m., Berlese No. 369 (rain forest, sieved litter), Nov. 6-8, 1981, 3 ♀ 9 ♂ (QM S.1496), 1 ♂ (MNH, DA 213); Bellenden Ker Range, Cable Tower 3, alt. 1054 m., Nov. 25-31, 1981, 1 ♀ 1 ♂ j. (QM S. 1498).

DESCRIPTION

Identical to the preceding species both in habitus and colour as well as in the relative dimensions of antennae, the gnathochilarium, the shape of the metatergal shoulders, the superficial texture of the teguments and the position of the macrosetae.

Even the dimensions (slightly larger here) and the number of ocelli are comparable, as shown in Table 7.

MALE SEXUAL CHARACTERS: Quite similar to those of the type-species, they differ from it only in certain minute details and in two more important aspects (Figs 46–49):

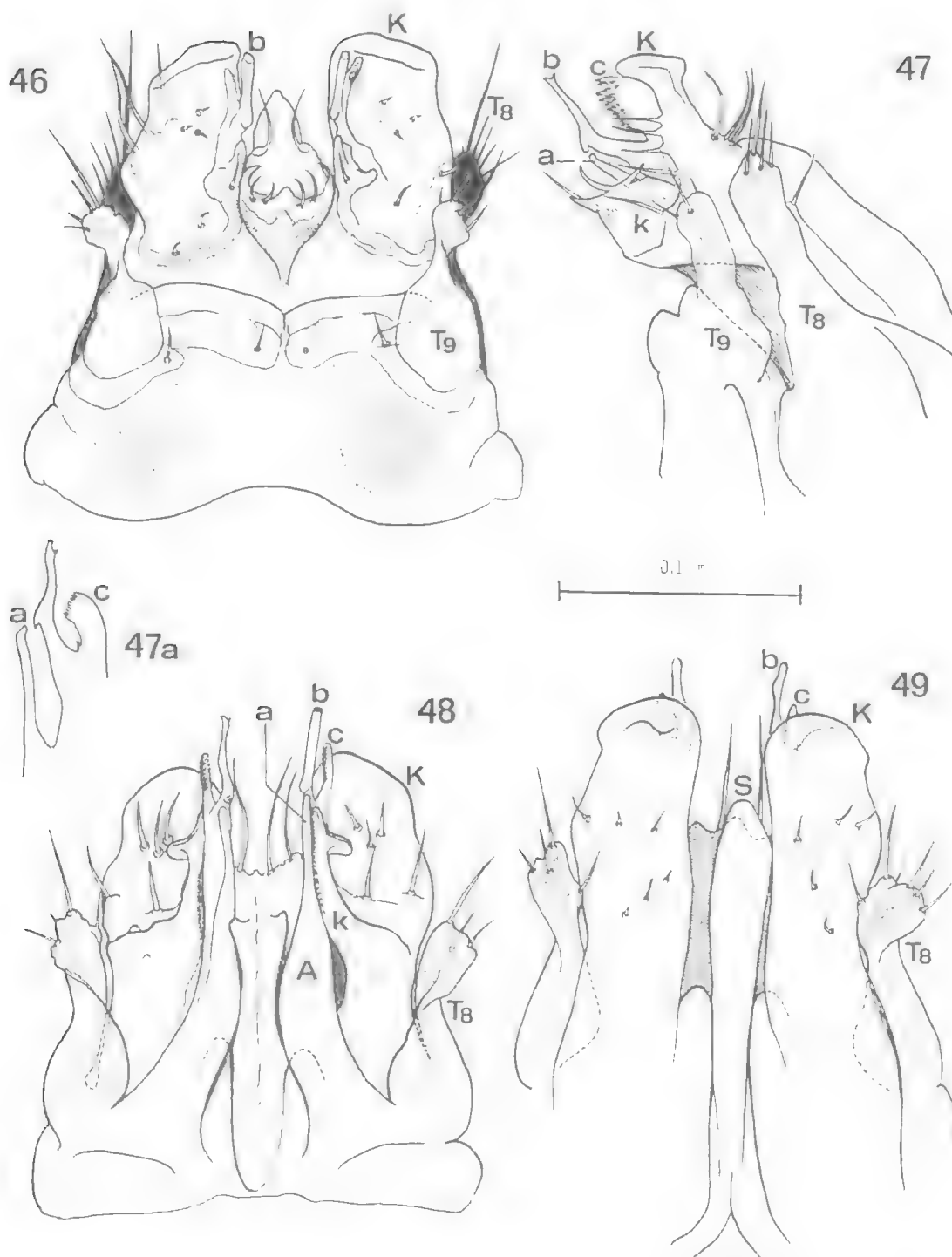
1. There is no trace of any separation at the base of the telopodites of the eighth pair (gonopods);
2. There is a third anterior branch (c), shorter

than the two others, bearing spinules apically. These spinules are also found in the type-species but are not carried on a differentiated branch (compare Figs 42 and 47a).

FEMALE SEXUAL CHARACTERS: When Figs 40 and 50 (oral view) and 41 and 51 (distal view) are compared, no significant difference between the two species is obvious, except for the absence of protuberances in *P. summa*, and perhaps in the distribution of setae.

TABLE 7. *Peterjohnsia summa*: Measurements (mm), number of rings (N), leg pairs (lp) and ocelli.

	N	lp	Length	Vertical diameter	Width	Length antenna	Ocelli
BKR, Berl. 336 ♂ holotype	30	48	4.3	0.38	0.52	0.40	10(1.2.3.3.1)
♂ paratype	30	48	4.2	0.38	—	—	9(1.2.3.3)
♂ paratype	30	48	4.2	0.40	—	—	10(1.2.3.3.1)
♂ paratype	30	48	4.2	0.41	—	—	10(1.2.3.3.1)
♂ paratype	30	48	4.3	0.40	—	—	10(1.2.3.3.1)
♂ paratype	30	48	4.1	0.42	—	—	10(1.2.3.3.1)
♀ paratype	32	54	5.2	0.53	—	—	11(1.2.3.3.2)
♀ paratype	32	54	5	0.48	—	—	11(1.2.3.3.2)
♀ paratype	32	54	4.6	0.48	—	—	11(1.2.3.3.2)
BKR, Berl. 338 ♂ paratype	30	48	4.3	—	0.49	—	10(1.2.3.3.1)
♀ paratype	32	54	4.7	0.50	0.62	—	11(1.2.3.3.2)
♀ paratype	32	54	4.8	—	0.61	—	13(1.2.3.3.3.1)
♀ paratype	32	54	4.7	—	0.59	—	10(1.2.3.3.1)
BKR, Oct. 25–31 ♂ paratype	30	48	5	0.40	—	0.50	8/9(1.2.2.2/3.1)
♂ paratype	30	48	4.4	0.40	—	—	10(1.2.3.3.1)
♂ paratype	30	48	4.8	0.42	—	—	10(1.2.3.3.1)
♂ paratype	30	48	4.8	0.40	—	—	10(1.2.3.3.1)
♂ paratype	30	48	4.7	0.38	—	—	10(1.2.3.3.1)
♂ paratype	30	48	5	—	0.55	—	9(1.2.3.3)
♂ paratype	30	48	4.4	—	0.55	—	10(1.2.3.2.1.1)
♀ paratype	32	54	(7.3)	0.50	—	—	12(1.2.3.4.2)
♀ paratype	32	54	6.1	0.50	—	—	11(1.2.3.3.2)
♀ paratype	32	54	4.8	0.46	—	—	10(1.2.3.3.1)
♀ paratype	32	54	5.8	0.52	—	—	11(1.2.3.3.2)
♀ paratype	32	54	5.9	0.51	—	—	11(1.2.3.3.2)
♀ paratype	32	54	4.9	0.50	—	—	11(1.2.3.3.2)
♀ paratype	32	54	5	0.53	—	—	11(1.2.3.3.2)
♀ paratype	32	54	5.3	0.45	—	—	11(1.2.3.3.2)
♀j. (A-1) paratype	30	48	4.2	—	0.51	—	10(1.2.3.3.1)
♀j. (A-1) paratype	30	48	3.8	0.42	—	—	10(1.2.3.3.1)
♀j. (A-1) paratype	30	48	4.3	—	0.51	—	9(1.2.3.2.1)
♀j. (A-1) paratype	30	48	4.9	0.43	—	—	12(1.2.3.4.2)
♀j. (A-2) paratype	27	40	3.7	0.32	—	—	8(1.2.3.2)
Bartle Frere ♂	30	48	4.4	0.40	0.55	—	9(1.2.3.2.1)
♂	32	54	4.9	0.50	—	—	11(1.2.3.3.2)
♂	32	54	4.9	0.51	—	—	10(1.2.3.3.1)
♂	32	54	5.1	0.52	—	—	11(1.2.3.3.2)
♂	32	54	4.9	0.48	—	—	10(1.2.3.3.1)
♂	32	54	5	0.50	—	—	9(1.2.3.3)
♂	32	54	4.9	0.52	—	—	10(1.2.3.3.1)
♂	32	54	4.8	0.50	—	—	9(1.2.2.2.2)



FIGS 46-49. *Peterjohnsia summa* n.g., n.sp., ♂ holotype: 46, caudal-ventral view (in black, telopodites of gonopods), of eighth pair (gonopods) and 9th pair (paragonopods); 47, isolated eighth pair, lateral view, 47a, detail of extremity of angiocoxite, lateral view; 48, isolated eighth pair, caudal view, 49, the same, oral view.

Peterjohnsia ludovicensis* n.sp.*MATERIAL EXAMINED**

HOLOTYPE: Australia, NE. Queensland, Hilltop 5.5 km north of Mount Lewis, alt. 1200 m., Berlese No. 297 (rainforest, sieved litter), Sept. 13, 1981, G. Monteith and D. Cook, 1♂ (QM S.1499).

PARATYPES: Same area, 5.5 km north of Mount Lewis, via Julatten, alt. 1100 m., Berlese No. 276 (rainforest, sieved litter), Sept. 8, 1981, G. Monteith & D. Cook, 1♂ 1♀ (QM S.1500).

DESCRIPTION

Identical in external morphological

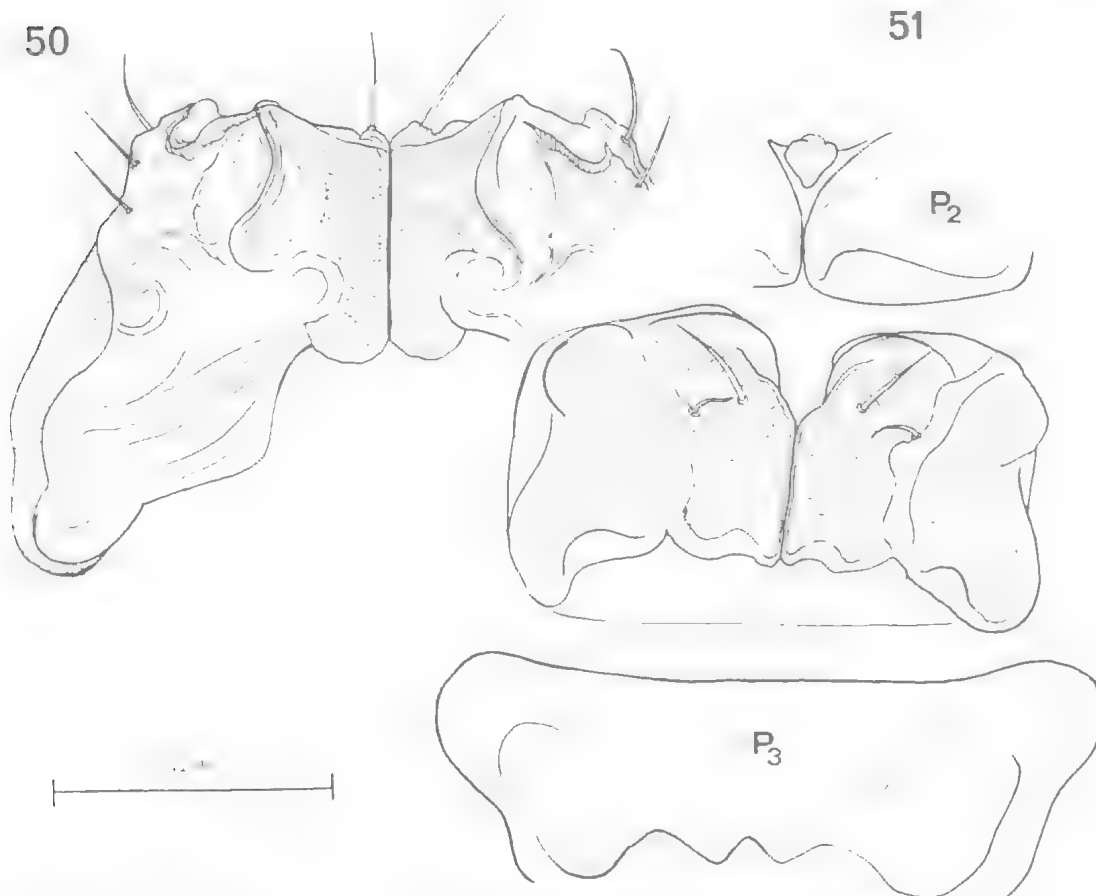
characteristics to other species. No significant difference is indicated by the measurements and number of ocelli, as can be seen in Table 8.

MALE SEXUAL CHARACTERS: The following differences can be observed:

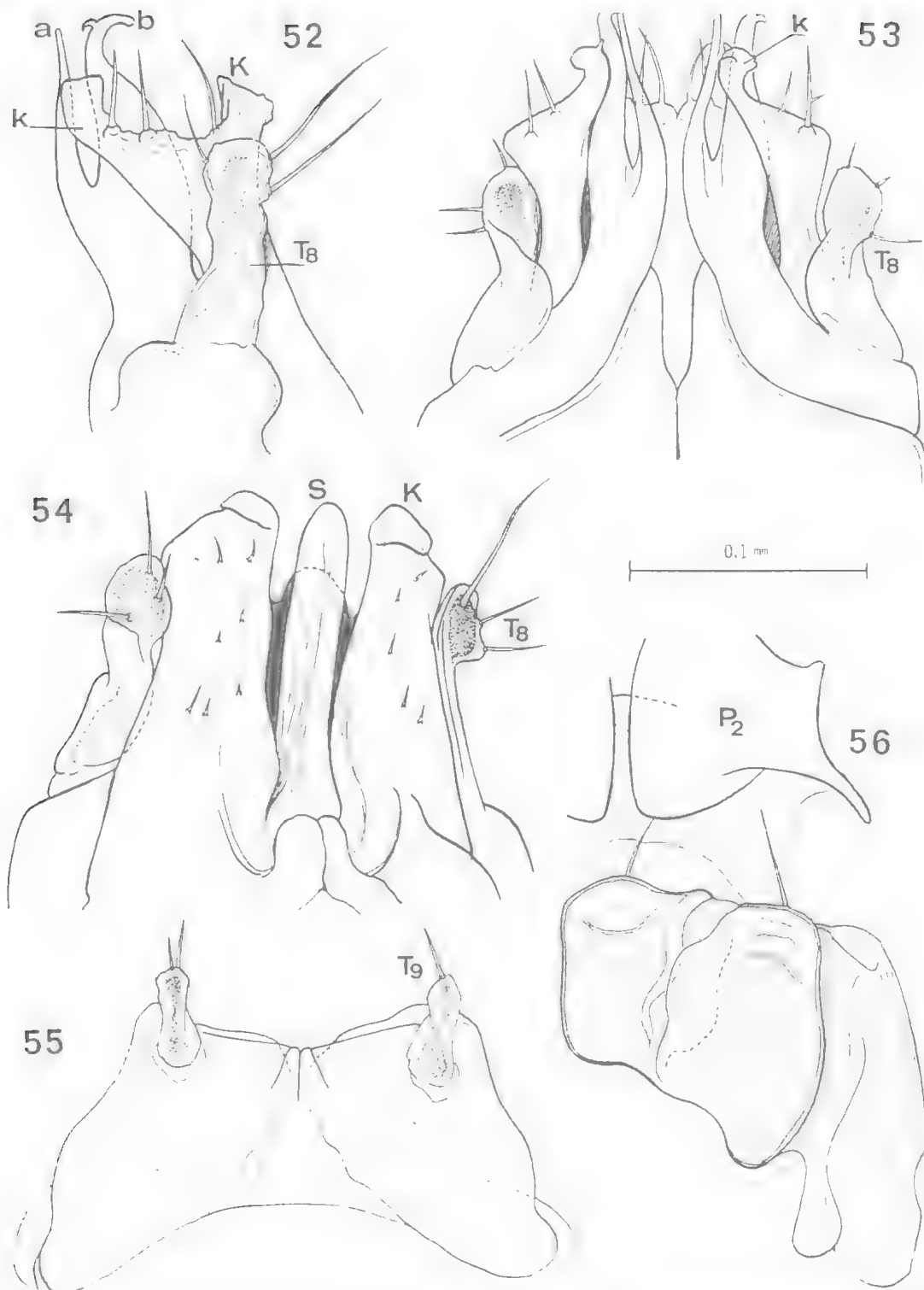
1. the foliated part K (anterior) of the colpocoxite is lower than the posterior branch (k) and therefore not visible in the caudal view (Fig. 53);
2. the angiocoxite (A) is bifid as in *basimontana*, but here, there is no trace of any spines on the

TABLE 8. *Peterjohnsia ludovicensis*: Measurements (mm), number of rings (N), leg pairs (lp) and ocelli.

	N	lp	Length	Vertical diameter	Width	Length antenna	Ocelli
♂ holotype	30	48	4.25	0.35	0.53	0.47	10(1.2.3.3.1)
♂ paratype	30	48	4.20	0.33	0.46	-	10(1.2.3.3.1)
♀ paratype	32	54	5.50	0.40	0.58	-	11(1.2.3.3.2)



FIGS 50-51. *Peterjohnsia summa* n.g., n.sp., ♀ paratype: 50. vulvae, caudal view; 51. the same, distal view.



FIGS 52-56. *Peterjohnsia ludovicensis* n.g., n.sp., ♂ holotype, ♀ paratype: 52. eighth pair (gonopods), lateral view; 53. the same, caudal view; 54. the same, oral view (slightly oblique); 55. ninth pair (paragonopods); 56. base of second left leg and left vulva, caudal view.

anterior part ('c' in figs. 42 and 47a) and the long, slender posterior branch (a) is, in this case, the same length as the oral branch (b), which here is shorter and sturdier than in the other species;

3. on the ninth pair (paragonopods, Fig. 55), the telopodites are located in a less lateral position.

FEMALE SEXUAL CHARACTERS: Fig. 56 reveals no important difference from the two other species; vulvar pilosity is even more sparse than in *P. summa*, as here there is only a single distal seta on each side of the vulva (one per valve).

ACKNOWLEDGEMENTS

I especially wish to thank Professor Peter M. Johns (Christchurch), who collected a great deal of the material studied in this article and who graciously told me it had been deposited in the Queensland Museum. Also many thanks to my colleague Valerie Davies, former Curator of Arachnids at the Queensland Museum, who arranged for all the Craspedosomids in her care to be sent to me for examination. I would like to pay tribute to the great spirit of co-operation shown by my colleague S. Golovatch (Moscow), who kindly kept me up to date in great detail, on his work concerning other Australian Craspedosomids. I am grateful to Michèle Bertoncini (M.N.H.M. Paris) for the numerous drawings that illustrate this article, and also particularly for her significant and competent contribution, to Anne Cooper (M.N.H.N. Paris) who translated this paper from French to English.

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REVISION OF THE AUSTRALIAN ZUPHIINAE 2. *COLASIDIA MONTEITHI* SP.
NOV. FROM NORTH QUEENSLAND, FIRST RECORD OF THE TRIBE LELEUPIDIINI
IN AUSTRALIA (INSECTA: COLEOPTERA: CARABIDAE).

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ABSTRACT

Colasidia monteithi sp. nov. is an inhabitant of lowland rainforest of northern Queensland. It is the first representative of the tribe Leleupidiini of the subfamily Zuphiinae recorded from Australia. *Colasidia monteithi* is apotypic within the genus *Colasidia* and is presumably derived from more plesiotypic ancestors similar to species still living in New Guinea. The high degree of apomorphy, and the present distribution, indicate that the ancestor of *Colasidia monteithi* was an ancient invader into Australia.

INTRODUCTION

Zuphiinae is a small but, especially in the Australian area, quite diverse group within the truncatipennian Carabidae. In Australia 12 species have been found. The genus *Planetes* is included here in the Zuphiinae although its systematic status is still controversial (see Jedlicka 1963; Habu 1967; Reichardt 1967; Darlington 1968). Genera known from Australia are *Zuphium* Latreille, *Parazuphium* Jeannel, *Acrogenys* Macleay, *Pseudaptinus* Castelnau, and *Planetes* Macleay. Since all species were described between 1862 and 1890, and because most of the diagnoses are unsatisfactory, only few species can be determined with certainty. A revision of the Australian Zuphiinae was started by Baehr (1984).

The tribe Leleupidiini was discovered only recently, but constitutes a rather extensive group (Basilewsky 1951, 1953, 1954, 1967) of small and oddly shaped beetles. Although, originally recorded from tropical Africa, mainly from the high mountains of East Africa, species were later described from Asia (Basilewsky 1954; Landin 1955). Since then, Leleupidiini also became known from Madagascar (Basilewsky 1967), and Darlington (1971) extended their geographical range to New Guinea, where two species are now known.

Very little is known about the habits of species of Leleupidiini, all discoveries having been made in the course of extraction or washing of soil and litter samples. All species seem to be rather rare. The three recorded species of the Asiatic-New Guinea genus *Colasidia*, for example, are known from single females only. Presumably the species are secretive and perhaps burrow in loose soil and litter. To my knowledge there are no indications of myrmecophilous habits in any species, but some

morphological attributes, e.g. the moniliform antennae, and the peculiar, enlarged, and glandular terminal segment of the labial palpi, could suggest such habits.

The discovery of a new species of the genus *Colasidia* by G.B. Monteith now extends the geographical distribution of the Leleupidiini to Australia.

Type material is lodged at the Queensland Museum (QM).

KEY TO THE AUSTRALIAN AND NEW
GUINEAN GENERA OF ZUPHIINAE

The diagnostic features of the Leleupidiini (for description of the tribe see Basilewsky 1951) can be gathered from the following key, which comprises all genera of Zuphiinae so far recorded from Australia and New Guinea.

1. First antennal segment short and thick, shorter than second and third segments together. Antennae moniliform, short, extending only to middle of pronotum, Head very long, eyes small, temples at least three times as long as eyes. Last segment of labial palpi extraordinarily large, square, asymmetrically fixed to second segment. Tribe Leleupidiini..... genus *Colasidia* Basilewsky

First antennal segment as long as, or longer than second and third segments together. Head shorter, temples at most three times as long as eyes. Last segment of labial palpi smaller, if extraordinarily large, then not square, nor asymmetrically fixed to second segment 2

2. Striae of elytra duplicate, thus elytra with 19 narrow ridges. Basal border of elytra entire. Basal three segments of δ anterior tarsus asymmetrically widened, biserially squamose. Squamosity oblique, in medio-distal direction. Tribe Planetini genus *Planetes* Macleay
 Striae of elytra not duplicate. Basal border of elytra not entire, δ anterior tarsus slightly widened, symmetrical. Squamosity of tarsus straight, biserial or uniserial only at inner edge of tarsus 3
3. Antennae short, moniliform, not attaining base of pronotum. First segment as long as second and third segments together. Head behind eyes wide, square, back of head straight, hardly narrowed. Eyes large. Last segment of maxillary palpi very large, enlarged to tip. Elytra parallel, apex roundish cut off, somewhat drawn in to middle. Elytra each with 6 fine ridges. Tribe Patriziini genus *Agastus* Schmidt-Göbel¹
 Antennae longer, not moniliform, extending beyond base of elytra. Last segment of maxillary palpi normal, only slightly enlarged to tip. Apex of elytra not rounded, nor drawn in to middle. Elytra at most with one ridge at seventh interval. Tribe Zuphiini (*sensu stricto*) 4
4. First antennal segment only as long as second and third segments together or slightly longer. Pronotum with several marginal setae in anterior half. Elytra with a row of 8 to 10 erect setae at third, fifth, and seventh intervals. Seventh interval carinate or at least considerably more raised than the other intervals. Flightless, elytra fused together.... genus *Acrogenys* Macleay²
 First antennal segment considerably longer than second and third segments together. Pronotum with one marginal seta in anterior half. Elytra without conspicuous erect setae at third, fifth, and seventh intervals. All intervals similarly shaped, mostly rather depressed. Generally winged, elytra free 5
5. Length of first antennal segment less than $1.5 \times$ second and third segments together. Posterior margin of head strongly rounded. Width of 'neck' at least $0.5 \times$ width of head including eyes. Elytra rather convex with considerably raised intervals, genus *Pseudaptinus* Castelnau
 Length of first antennal segment nearly $2 \times$ second and third segments together. Posterior margin of head rather truncate. Width of 'neck' less than $0.5 \times$ width of head including eyes. Elytra depressed, intervals flat, at most very feebly raised, 6
6. Larger, length over 7.5 mm. Elytra with distinct intervals. First antennal segment with one long tactile seta near tip..... genus *Zuphium* (*sensu stricto*) Latreille
 Smaller, length less than 7 mm. Intervals hardly perceptible. First antennal segment with several long tactile setae genus *Parazuphium* Jeannel

Colasidia Basilewsky

Colasidia Basilewsky, 1954, p. 215, fig. 1. Darlington, 1971, p. 332.

Type species: *Colasidia malayica* Basilewsky, 1954.

DIAGNOSIS

Genus of the tribe Leleupidiini Basilewsky of the subfamily Zuphiinae. Ant-like, small zuphiine beetles with fairly small eyes. Tooth of mentum long, nearly as long as lateral lobes, tip rounded or feebly notched. Last segment of labial palpi very large, square, just about two times longer than wide. Punctures of dorsal surface very coarse. Wings in all known species atrophied.

KEY TO THE KNOWN SPECIES

1. Eyes larger, roundish, length of eyes about one third of length of temples behind eyes. Head wider across eyes than across temples. Hind part of head strongly rounded (New Guinea)..... *C. papua* Darlington, 1971
 Eyes smaller, oblique, length of eyes less than one third of length of temples. Head widest at a distance behind eyes 2
2. Posterior border of temples feebly rounded off. Posterior part of head nearly straight. Head decidedly trapezoidal, wider than pronotum. Posterior angles of pronotum blunt, just slightly projecting (Singapore)..... *C. malayica* Basilewsky, 1954

¹A species of the genus *Agastus*, hitherto only recorded from southeast Asia and from Africa, has been recently found in New Guinea (Baehr 1985). Members of that genus are likely to be discovered in northern Australia.

²*Acrogenys australis* Blackburn 1890 is a species of the genus *Pseudaptinus* Castelnau.

Posterior border of temples decidedly rounded off. Thus, posterior part of head rounded. Head not strikingly trapezoidal, narrower than pronotum. Posterior angles of pronotum acute and projecting. Sides in front of posterior angles strongly curved 3

3. Elytra short and wide, very convex, less than $1.5 \times$ as long as wide, more than $2 \times$ wider than pronotum. Pronotum short, nearly as wide as long ($0.95 \times$). Head short, nearly as wide as pronotum. Ratio length of head (labrum to anterior border of 'neck') to width of head less than 1.75 (New Guinea)
..... *C. madang* Darlington, 1971

Elytra rather elongate, more than $1.5 \times$ as long as wide, only $1.75 \times$ as wide as pronotum. Pronotum conspicuously narrower than long ($0.85 \times$). Head elongate, distinctly narrower than pronotum ($0.8 \times$). Ratio length of head to width of head more than 2 (Australia, North Queensland)
..... *C. monteithi* sp. nov.

Colasidia monteithi sp. nov.

MATERIAL EXAMINED

HOLOTYPE: QM T.9181, presumably ♀ (sex not confirmed by dissection). Australia, North Queensland, 2 km WNW of Cape Tribulation ($16^{\circ}05'S$, $145^{\circ}28'E$). 23.ix.-7.x.1982, G. Monteith, D. Yeates & G. Thompson.

DESCRIPTION

Measurements: Overall length: 5.18 mm, length to apex of elytra: 4.47 mm, maximum width: 1.32 mm.

Colour: Head and pronotum reddish-brown, elytra blackish. Labrum, antennae, mouthparts, and legs yellow. Lower surface dark reddish, first abdominal segments brownish, last three abdominal segments dark brown to black.

Microsculpture: Upper surface rather sparsely, but very coarsely and rather regularly, punctate, sparsely hirsute, with long, yellow hairs. Pilosity partly inclined, partly erect. No microsculpture visible between the punctures. Also lower surface and legs wholly punctate and hirsute.

Head: Very elongate (more than twice as long as maximum width). Head steadily tapering from posterior border to front. Eyes small, very oblique, temples behind eyes about $5 \times$ longer than diameter of eye, rounded off behind. 'Neck' one third of width of head. Frontal furrows long, not reaching anterior border of eyes. Frons and vertex convex. A straight ridge from median border of eye to base of antenna. Above base of antenna a

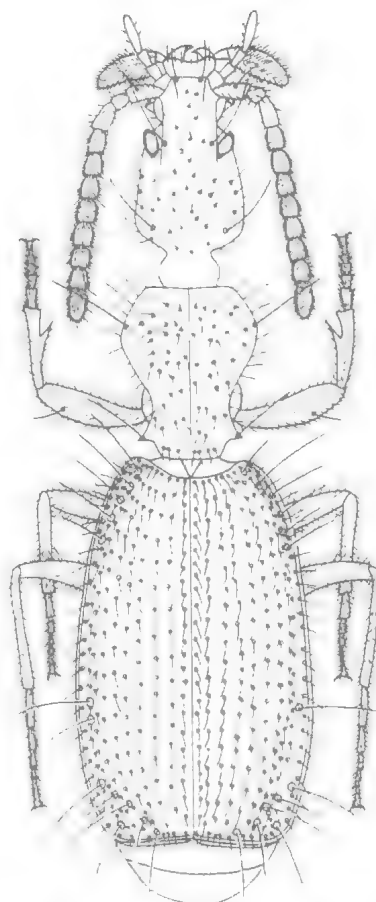


FIG. 1: *Colasidia monteithi* sp. nov. Habitus. Scale = 1 mm.

triangular prominence. Anterior supraorbital seta at anterior border of eye, posterior seta far away from eye near posterior border of temples. Clypeus not divided from frons, clypeus smooth, with two long setae and several short bristles along anterior border. Labrum rather large, anterior border feebly notched, side parts widened, thus, basal parts of mandibles concealed. Labrum six-setose, sides with several additional short bristles. Mandibles short, inner border straight, apex suddenly hook-like curved. Mentum with a long and stout, entire tooth which is only slightly shorter than lateral lobes, bisetose. Epilobes distinctly separated, longer than lobes, tip somewhat curved inwards. Glossa corneous, apex truncate, bisetose. Paraglossae membranaceous, much longer than glossa, distally strongly curved inwards. Terminal segment of labial palpi very large, square, about twice as long as wide, entire

surface with long and dense pilosity, ventrally with a long glandular cleft. Penultimate segment with some bristles. Base of maxillae laterally protruding, with some long hairs. Galea sparsely hirsute. Basal part of lacinia wide, corneous, lateral border bristled, distal part narrower and only weakly corneous. Median border of lacinia not dissected. Maxillary palpus fairly small, pointed, last segment sparsely pilose. Antennae short, moniliform, extending to apical third of pronotum. Basal segment $0.8 \times$ as long as second and third segments together. Segments 4–10 shorter than wide. Basal segment with a long tactile seta and several short bristles, remaining segments with an apical row of long setae and with a double, very dense pilosity, mixed from long and erect, and short and depressed hairs, respectively.

Pronotum: Distinctly shorter and wider than head (ratio width of head/width of pronotum: 0.79), and clearly longer than wide (ratio width of pronotum/length: 0.83), heart-shaped. Sides strongly curved to the rounded anterior angles, widest in front of first third. Sides concave in front of the pointed and prominent posterior angles, these slightly advanced from base. Base straight. Sides bordered, without lateral groove, apex and base not bordered. Basal grooves indistinct due to the coarse punctures. Median line complete, but fairly indistinct. Pronotum convex, coarsely punctate, with sparse, erect pilosity. One lateral seta each a short distance in front of first third and at the protruding posterior angles.

Elytra: Broadly oval and strongly convex, about $1.5 \times$ longer than wide, less than twice as wide as

pronotum (ratio width of elytra/width of pronotum: 1.76), widest in last third. Shoulders rounded off, apex transversely cut off, somewhat drawn in to middle, bordered. Beyond apical border with a narrow, membranous band. Striae distinguished only by the very coarse, but fairly regular punctures. No basal pore visible. Pilosity fairly sparse, but elongate, obliquely erect. Border along ninth stria basally with a row of about six, behind middle with one or two, and near apex with about six umbilicous pores and very long setae. Also lateral border of elytra pilose. No elytral pores recognizable. Elytra fused together, hind wings reduced.

Lower surface: Wholly hirsute, with exception of proepisterna (only anteriorly hirsute) and of anterior parts of first abdominal sternites. Sternites with a long seta on each side, last sternite with one seta each side (?). Metepisternum quadrate.

Legs: Fairly elongate, especially posterior tarsus. Whole legs densely hirsute, lower parts of all tarsal segments pilose. Clawy smooth.

♂ aedeagus: Not known.

Immature stages: Unknown.

DISTRIBUTION

Only known from Cape Tribulation at the base of Cape York Peninsula, northern Queensland.

HABITS

The unique specimen of *Colasidia monteithi* was discovered by use of Berlese-extraction of leaf litter. According to G.B. Monteith's information the collecting area is one of the wettest in Australia and has still a very luxuriant rain forest flora. Apart from this information, virtually nothing is known about the habits of this beetle, as is the case in all other species of the genus. The circumstances of discovery, the small eyes, short antennae, and the 'stream-lined' body shape all point to a habit of living in leaf litter or loose soil. Striking peculiarities are the very large, glandular terminal segments of the labial palpi, which are reminiscent of the antennal clubs of Paussinae. Perhaps, they can be regarded as an indication of a myrmecophilous habit.

DISCUSSION

Colasida monteithi is distinguished from the three other species of the genus by its very narrow body shape, especially by the exceptionally elongate and narrow head and by the small and oblique eyes. The narrow head — in comparison to the pronotum — and the coarsely punctate

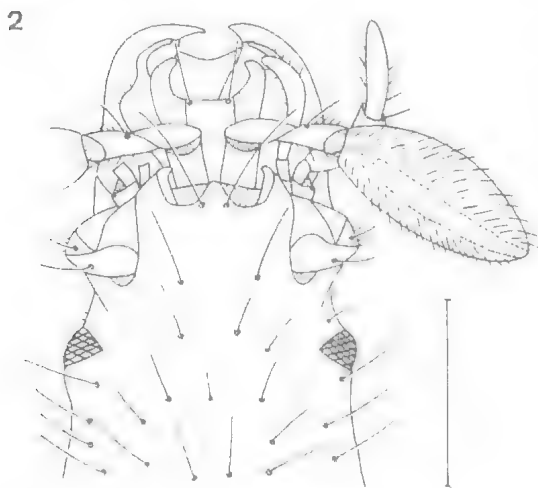


FIG. 2: *Colasidia monteithi* sp. nov. Lower side of head. Scale = 1 mm.

upper surface are shared by *C. monteithi* and both species from New Guinea, *C. papua* and *C. madang*, which indeed seem to be the nearest relatives of *C. monteithi*. Additional diagnostic differences between these species and *C. monteithi* are given in the key.

If large eyes and the rounded, less widened back of the head are interpreted as plesiomorphic character states, then *C. papua* seems to constitute the most primitive species of the genus. Reduction of eyes and elongation, or widening of the back of head can be interpreted as adaptations to a secretive life in soil or litter or in the upper soil strata proper, and they must be regarded as apomorphic character states. Reduction of eyes is most striking in *C. malayica* and *C. monteithi*, whereas *C. madang* is intermediate between these species and *C. papua*. The same is true concerning the deformation of the head and the extreme widening and development of its angular hind edges in *C. malayica*, and the extreme elongation of the head in *C. monteithi*. In these characters *C.*

madang is also intermediate. From this viewpoint *C. malayica* and *C. monteithi* constitute the most apotypic species. *C. malayica*, however, seems still more divergent morphologically than *C. monteithi*. At the same time the geographical ranges of these two species are located at the limits of the known range of the species within the genus. With regard to distribution, *C. malayica* is the most isolated of the species.

It is likely that the centre of origin of the genus *Colasidia* was in New Guinea, where the most plesiotypic species live. From there the apotypic species spread to the north (Malaysia) and to the south (North Queensland). This view is opposite to that of Darlington's (1971), according to whom the (presumably winged) ancestors of the New Guinean species came from the Oriental area.

With regard to the distribution of the whole tribe Leleupidiini, I must agree that the ancestors of the genus *Colasidia* originated in the Oriental Region. The recent distribution of the species, however, points to a secondary migration from

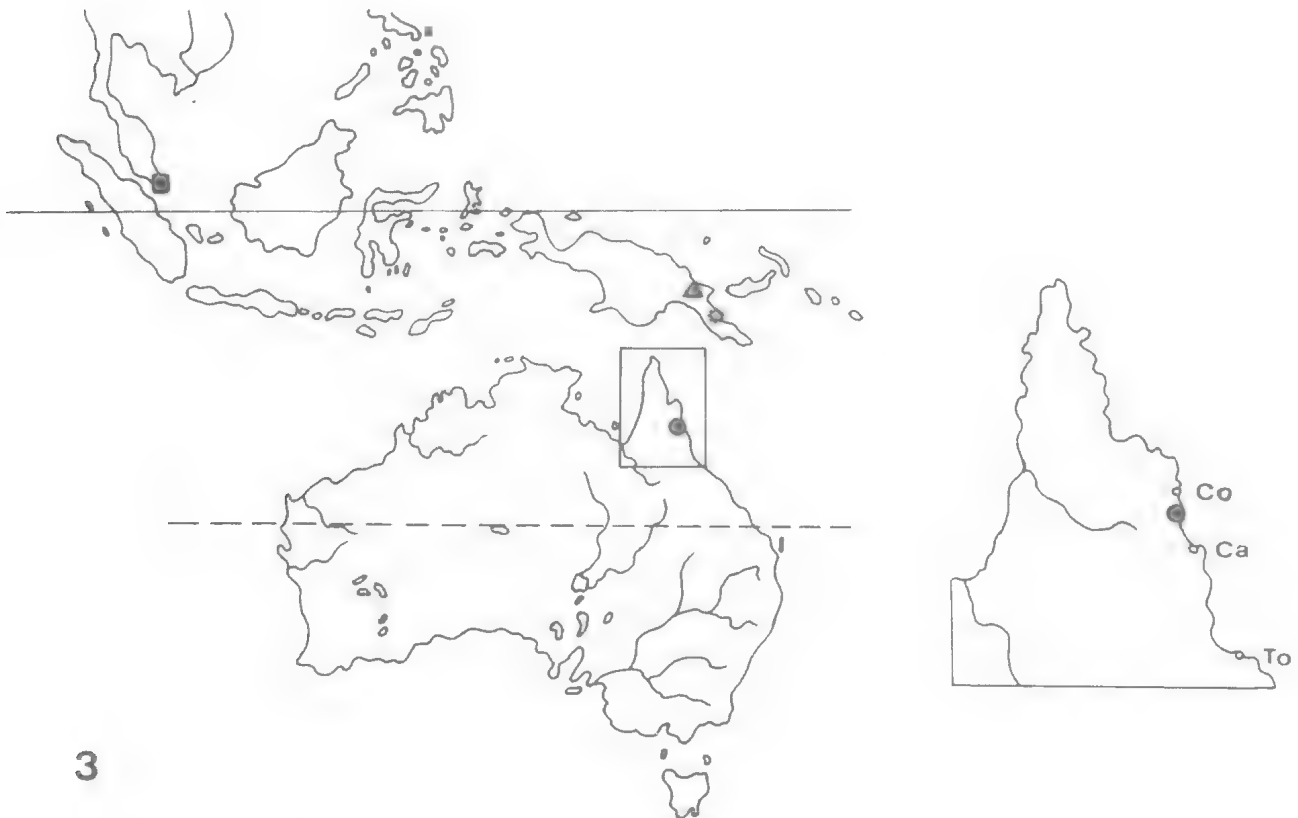


FIG. 3: Distribution of the species of the genus *Colasidia*: ■ = *C. malayica* Basilewsky, ▲ = *C. madang* Darlington, ★ = *C. papua* Darlington, ● = *C. monteithi* sp. nov. Co = Cooktown, Ca = Cairns, To = Townsville.

New Guinea back to the north and, on the other hand, to a migration further south to northern Australia.

In any case my view of the distribution pattern of the genus could be changed substantially if, for example, further species should be discovered in Southeast Asia or in the Indonesian Islands. Because of their secretive habits and their obvious rarity this will require special and careful searching.

Regarding Australian zoogeography it must be stressed that the single Australian species represents an apotypic form within the genus *Colasidia*. The presence of related species in New Guinea suggests that the ancestor of *Colasidia monteithi* immigrated to Australia from the north via Cape York Peninsula. This has been suggested before for other rainforest species (Darlington 1961). Since all recent species of *Colasidia* are flightless it may be supposed that immigration could only take place step by step at short distances over land. Hence immigration into Australia was only possible at times when the water gaps between New Guinea and North Queensland were considerable narrower, and when rain forests in North Queensland covered much larger areas and were contiguous. This high degree of apomorphy in several morphological characters and the distribution at the base of Cape York Peninsula clearly demonstrates that *C. monteithi* is not a recent immigrant from New Guinea, but that it represents a fairly old member of the soil living fauna of the rain forests of North Queensland.

ACKNOWLEDGEMENTS

I want to express my warmest thanks to Dr G.B. Monteith (Queensland Museum, Brisbane) for offering the unique specimen of *Colasidia monteithi* for examination and description. I also heartily thank Dr A.F. Newton, Jr. (Cambridge,

Mass.) for sending on loan the type of *Colasidia papua*.

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THE GENUS *NEOLAXTA* MACKERRAS (DICTYOPTERA : BLATTARIA :
BLABERIDAE)

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ABSTRACT

Three species of the Australian genus *Neolaxta* are described, two of which, namely *mackerrasae* and *triangulifera*, are new. The generic description is modified, and a key is given to distinguish both sexes of the species. *Neolaxta* is very close to *Laxta* and can only be separated from it by spines on the anteroventral margin of the front, or all femurs; this character may be poorly developed or absent in the female.

INTRODUCTION

The Australian cockroach genus *Neolaxta* was based on a single species. In this paper I describe 2 new species and modify Mackerras's diagnosis of the genus.

The following Museums and their curators lent me specimens: ANIC — Australian National Insect Collection, CSIRO, Canberra, A.C.T., Australia; Dr D.C.F. Rentz and Mr John Balderson; MCZH — Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A.; UQLA — Department of Entomology, University of Queensland, St. Lucia, Queensland, Australia; Miss M. Schneider, through Dr G.B. Monteith; QM — Queensland Museum, Brisbane, Australia; Dr G.B. Monteith.

Genus *Neolaxta* Mackerras

Neolaxta Mackerras, 1968, p. 143; type species by monotypy, *Neolaxta monteithi* Mackerras, 1968, pp. 143–6.

DIAGNOSIS (from Mackerras)

Sexes dissimilar, males with long wings, females apterous. Head concealed beneath pronotum; face tuberculate. Anterior and lateral margins of pronotum angularly raised; pronotum of males and all terga of nymphs and females tuberculate, giving the nymphs and females a hard knobby feeling. Legs short and slender; anteroventral margins of fore femora with several large spines proximally, followed by a row of fine spinules distally, other femoral margins unarmed; tarsi short and bare, pulvilli large, arolia rather small, claws symmetrical. Terga and sterna of male fairly

smooth; T10 short, rounded; cerci blunt, short, but projecting well beyond T10. Terga of females and nymphs bearing 2–3 rows of large pale tubercles and numerous smaller dark ones; T10 of similar shape to that of male, but cerci very short, stout, not projecting as far as T10. S9 of male asymmetrical, with very short slender styles. Sterna of female smooth medially, minutely tuberculate laterally, S7 large, smoothly rounded, bare in centre and tuberculate laterally. The genus is distinguished from *Laxta* by the angularly up-turned edges of the pronotum, the regularly arranged very large pale tubercles on the dorsum, the possession of large spines on the anteroventral margin of the fore femur and densely tuberculate face, and the irregular development of the branches of CuA in the male.

The two new species of *Neolaxta* do not have many of the above characters which are best used for specific determination of *monteithi*. Males of the new taxa do not have a tuberculate face, and the anterior and lateral edges of their pronota are not angularly turned upwards (in some species of *Laxta* the head, at least in part, may be tuberculate, and the large tubercles on the dorsum may be regularly arranged). The antero- and posteroventral margins of the mid and hind femora may have a few small spines, similar to those on the front femur. The new species of *Neolaxta* are similar to species of *Laxta*, except for the presence of large spines on the ventral margin of the front femur (Fig. 3D), or all femora, and this is the only character to separate these genera. However, the femoral spines may be very small and reduced in numbers, or lacking in some

females and nymphs, and these individuals can be easily mistaken for species of *Laxta*. The genitalia (male and female) are similar in both genera.

The distance between the eyes may be greater or less than the length of the first antennal segment; this can be shown by calculating an eye antennal index (EAI) which is the interocular distance (measured near the top of the head, where the eyes are closest together) divided by the length of the first antennal segment.

Males of *Neolaxta* are very rarely seen free-living in the field and most are collected at light, occasionally in considerable numbers (Monteith, personal communication).

KEY TO ADULTS OF *NEOLAXTA*

1. Males (winged) 2
Females (apterous)..... 4
2. Pronotum with anterior and lateral margins strongly incrassated and raised (Fig. 2A). Anteroventral margins of mid and hind femora unarmed *monteithi*
Pronotum with anterior and lateral margins not thickened or raised (Figs. 3A, 4A). Anteroventral margins of mid and hind femora with 1-6 small spines (similar to those on the front femur)..... 3
3. Hind margin of supraanal plate broadly rounded (Fig. 1E). Anteroventral margin of front femur usually with 12-26 (rarely 4-8) small spines, those with large numbers occupying practically the full length of the margin (Fig. 3D). Pronotal punctations not half-moon-shaped *mackerrasae*
Hind margin of supraanal plate with a median triangular projection (Fig. 1H). Anteroventral margin of front femur with 2-4 widely spaced spines. Pronotal punctations partly pigmented, half-moon-shaped (Fig. 4A) *triangulifera*
4. Pronotum with anterior and lateral margins strongly incrassated and raised (Fig. 2C). Head densely tuberculate (Fig. 2D)..... *monteithi*
Pronotum with anterior and lateral margins not thickened or raised (Figs. 3I, 4C). Head not tuberculate (Fig. 4D)..... 5
5. Hind margin of supraanal plate trilobate (Fig. 4C). Abdominal tergites not granulate, tubercles few in number and widely spaced along the hind margins of the segments (Fig. 4C) *triangulifera*

Hind margin of supraanal plate weakly convex (Fig. 3I). Abdominal tergites granulate, and with tubercles arranged in 2 or 3 rows (Fig. 3I) *mackerrasae*

Neolaxta monteithi Mackerras (Figs 1A-D; 2A-E)

Neolaxta monteithi Mackerras, 1968, pp. 143-6, figs 1-4, pl. 1, figs 1-6 (male and female).

MATERIAL EXAMINED

HOLOTYPE: male, Tooloom, New South Wales, 30.xii.1966, G.B. Monteith, QM T.6621.

PARATYPES: 1♀, originally from Tooloom, New South Wales, ex C.S.I.R.O., colony no. 244, Canberra, A.C.T., in the QM. Same locality and colony data, 3♂, 1♀, 30.xii.1966, G.B. Monteith, in ANIC.

OTHER MATERIAL: QUEENSLAND, UQLA: Bald Mtn. area, 3000-4000', via Emu Vale, 1♀, 27-31.i.1972, 1♀, 26-30.i.1973, G.B. Monteith, 1♀ (genitalia on slide no. 6), 26-30.i.1973, B. Cantrell; Boldery Park, Cooyar, 12♂, 1♀, 24.x.1975, Monteith and Lambkin; Cooyar, Maidenwell Road, 2♀, 12.i.1975, G.B. and S.R. Monteith; Saddletree Ck., Bunya Mts., 1♂ (terminalia on slide no. 5), 24.x.1975, Monteith and Lambkin; Levers Plateau, via Rathdowney, 3♂, 31.x.1976, G.B. Monteith; Lawes, 1♂, 2.iii.1954, V.R. Catchpoole. ANIC: Bunya Mts., 1♂, 1♀, 17-18.ix.1966, G. Monteith and B. Cantrell; Emu Ck., under log, 1♀, 27.7.1967, S.V. Mark; Nanango, 1♀, 4.v.1964, G. Monteith. NEW SOUTH WALES, ANIC: Unumgar State Forest, via Kyogle, 1♀, 1♂ nymph, 11.iv.1966, T. Weir; C.S.I.R.O. colony 244, ex Tooloom, N.S.W., 7♀, 6♂ and 5♀ nymphs, 30.xii.1966, G.B. Monteith. QUESTIONABLE LOCALITY, ANIC: 15 miles E. of Busselton, Western Australia, 2♀, 1.xi.1967, G. McCutcheon (with following label: 'Data probably wrong; M.J. Mackerras cannot recollect specimens from this locality — J. Balderson, 21.xii.1969').

DESCRIPTION

MALE: Distance between eyes greater than the length of the first antennal segment (EAI = 1.2-1.7). Head with frons, vertex, and genae rough (rugulose and tuberculate) (Fig. 2B). Pronotum subelliptical, anterior and lateral margins thickened and raised (Fig. 2A), dorsal surface rugulose, with sparse large tubercles, ventral surface rugulose with a fine ridge on either side of the hood where the edge is turned upwards. Abdominal tergites smooth, all posterolateral angles rounded. Supraanal plate convex (Fig. 1B), hind margin thickened, not reaching hind margin or subgenital plate. Subgenital plate weakly asymmetrical, right and left sides slightly concave, distal region curved upwards, styles short, slender, inserted on the lateral margins (Fig. 1C). Anteroventral margin of front femur with 1-9

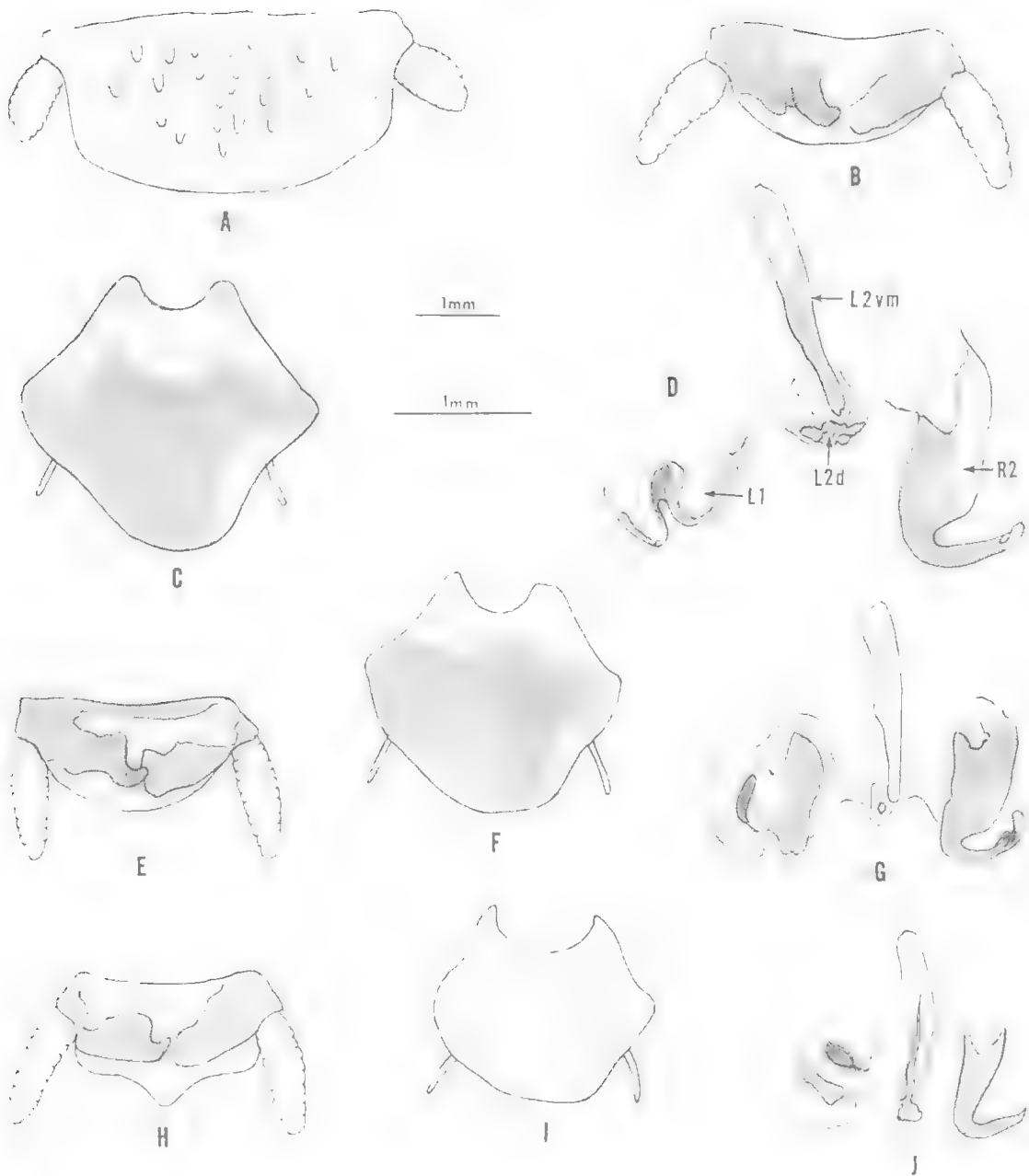


FIG. 1: *Neolaxta* spp. from Queensland. A-D. *N. monteithi* Mackerras: A. Female from Bald Mt. area, supraanal plate. B-D. Male from Saddletree Ck., Bunya Mts., supraanal plate and paraprocts, subgenital plate and styles, and genital phallomeres, respectively. E-G. *N. mackerrasae*, n. sp., male paratype from Mt. Fisher: E. Supraanal plate and paraprocts; F. Subgenital plate and styles; G. Genital phallomeres. H-J. *N. triangulifera*, n. sp., male paratype from 3.0 km west of Cape Tribulation: H. Supraanal plate and paraprocts; I. Subgenital plate and styles; J. Genital phallomeres.

Male supraanal plates are ventral views; subgenital plates, and genital phallomeres are dorsal. The phallomeres are shown in their normal position (L1 and L2 = sclerites of the left phallomere; L2vm = medial sclerite or L2 ventromedial; R2 = sclerite of the right phallomere). All drawn from slide preparations. Small scale refers to the supraanal and subgenital plates, large bar to the genital phallomeres.

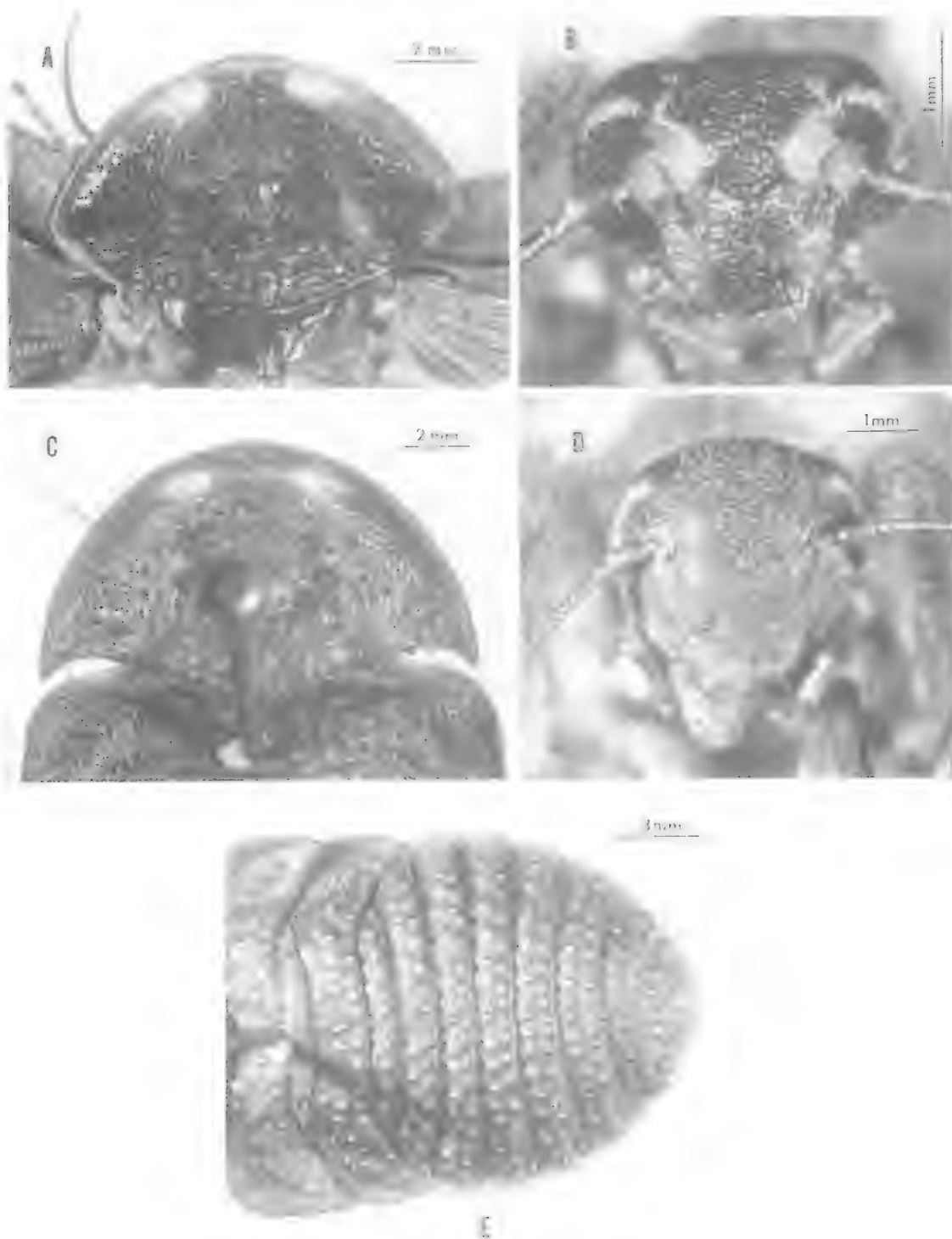


FIG. 2: *Neolaxta monteithi* Mackerras, from Tooloom, New South Wales. A, B. Male holotype, pronotum and head (frontal), respectively. C-E. Female paratype, pronotum, head (frontal), and abdomen (plus metanotum and part of mesonotum), respectively.

short robust spines on basal half, followed by some spaced spinules distad, margins of mid and hind femora unarmed. Genitalia as in Fig. 1D; L2d separated from L2vm; R2 with a subapical incision.

Colouration: Head mostly dark brown, ocelliform spots pale, margin of clypeus yellow, labrum light brown with yellow margin, genae reddish brown. Antennae with 2–3 pale segments near the apex. Pronotum with thickened raised anterior and lateral margins amber, surface tubercles reddish, medial region dark reddish brown. Lateral zones dark brown, anteriorly with a yellowish spot on either side of the midline. Tegmina and hind wings dark brown except for the clear anal area of the wings.

Measurements (mm): Body length, 18.0–24.0; pronotum length \times width, 4.8–5.8 \times 7.1–8.9; tegmen length, 20.0–25.7; interocular distance, 1.0–1.1; length of first antennal segment, 0.6–0.8.

FEMALE: Interocular distance about 2 or more times the length of the first antennal segment (EAI = 1.9–2.5) (Fig. 2D). Head entirely densely tuberculate, the tubercles on the vertex somewhat sparser (Fig. 2D). Entire dorsal surface of thorax and abdomen densely covered with granules, and large apically rounded tubercles, the latter on the abdomen arranged transversely in 2 rows (except for a single row on T1) (Fig. 2E). Pronotum more or less semicircular, with produced posterolateral corners, anterior and lateral margins incrassated and upturned (Fig. 2C), ventral surface of upturned region granulate, a slender ridge on each side of the hood as in the male. Abdominal tergites with lateral angles blunt, not produced, their sides only slightly overlapping the sternites (Fig. 2E). Supraanal plate with lateral margins concave to accommodate the short cerci which do not reach the convex hind margin of the plate (Figs 1A, 2E). Abdominal sternites with lateral regions pitted and granulate. Anteroventral margin of front femur with 4–10 spines on the basal half, these less distinct than in the male.

Colouration. Head dark brown. Labrum and lower half of clypeus yellowish. Pronotum dark reddish brown with a pale spot anteriorly on each side of the midline. Abdominal tergites similar to base colour of the pronotum. Coxae, femora, and tibiae brown, trochanters, knee spots, and tarsi yellowish.

Measurements (mm): Body length, 16.7–22.7; pronotum length \times width, 5.0–6.5 \times 9.0–11.6; interocular distance, 1.5–1.6; length of first antennal segment, 0.6–0.8.

REMARKS

The raised and thickened margins of the pronotum in both sexes make this species distinctive. The females may vary considerably in size; one of the smaller females (pronotum length \times width, 5.5 \times 9.0) was unequivocally an adult because it had an ootheca in its uterus. An ootheca removed from one of the larger females contained 24 partly developed embryos. Mackerras (1968) reported that one female produced 28 young, and they require about a year to mature.

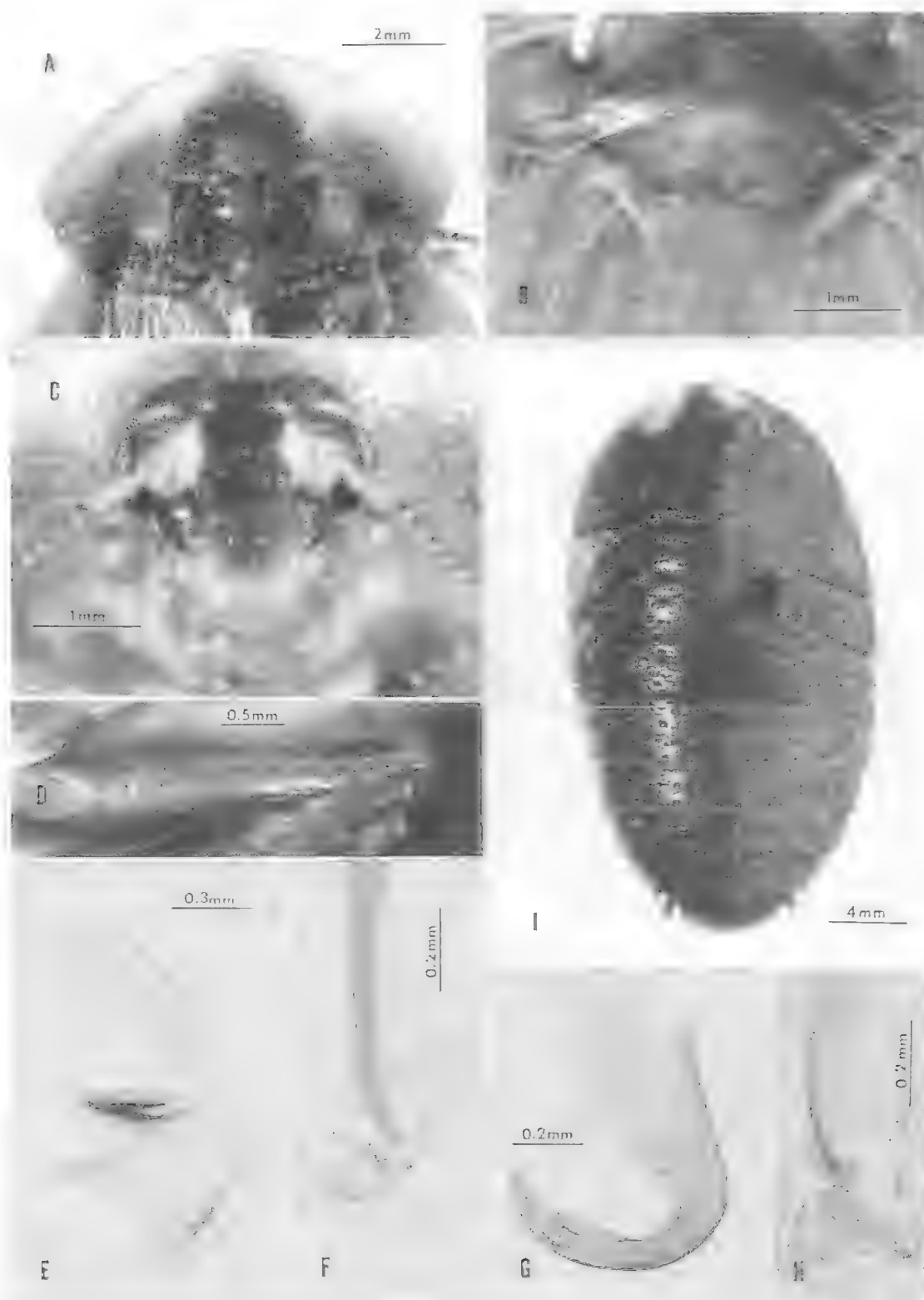
Dr G.B. Monteith (personal communication) states that *N. monteithi* 'is always found under stones and bits of wood lying on the ground; it tends to rest on the ground rather than on the object'.

Neolaxta mackerrasae n.sp. (Figs 1E–G; 3A–I)

MATERIAL EXAMINED

HOLOTYPE: male, Kirrama St. For., 32 km NW of Cardwell, Qld., 800 m, flight intercept trap, rain forest, 23.vi.–8.viii.1982, S. and J. Peck, SBP 46; in ANIC.

PARATYPES: QUEENSLAND. ANIC: Danbulla, 1♀, 30.vi.1951, F.J. Gray; near Cairns, 2♀ (dried out of spirit), Aug. 1966, H.M. Cameron; Moses Ck., 4 km N by E of Mt. Finnigan, nr. Cooktown, 15.47S 145.17E, 1♂, 14.x.1980, 1♀, 15.x.1980, 2♂ nymphs, 14–16.x.1980, T.A. Weir and R.A. Barrett; Lake Barrine, 1♂, 15.vii.1933, H.A. Gray. The following were collected in a flight intercept trap, rain forest, by S. and J. Peck: Same data as holotype, 5♂; Lacey's Creek, 10 km SE of El Arish, 40 m, 6♂, 23.vi.–5.viii.1982, SBP 47; Rosina Creek, 14 km SE of Millaa Millaa, 720 m, 5♂, 24.vi.–2.viii.1982. The following were collected by J. Balderson: Davies Ck., 20 km E by S of Mareeba, 17.02S 145.37E, 3♀, 1♀ nymph, 19.xi.1981; Palmerston Nat. Park, 24 km E by N of Ravenshoe, 17.35S 145.43E, 1♀, 14.xi.1981; Mt. Haig, 21 km NE by N of Atherton, 1♀, 17.xi.1981. The following were collected by I.F.B. Common and M.S. Upton: Mt. Edith, 18 mls NE of Atherton, 3400 ft, 2♀, 17.iii.1964; Mt. Lewis, 8 mls NW of Mt. Molloy, 3200 ft, 1♀, 18.iv.1964. MCZH: Millaa Millaa, Atherton Tab., 2500 ft, 1♀ nymph, April 1932, Darlington, Australia Harvard Exp.; Kuranda, 1♀. QM: Rex Lookout via Mossman, rain forest, 1♀, 13.x.1980, G.B. Monteith. The following were collected by G.B. Monteith and D.K. Yeates: Majors Mt., 7 km SE of Ravenshoe, 1000–1100 m, 1♀, 4.v.1983; Mt. Demi, 7 km SW of Mossman, 900–1000 m, 1♀, 26.iv.1983. The following were collected by Earthwatch/Qld. Mus.: Mt. Bartle-Frere, Sth. Peak Summit, 1620 m, 1♀ (genitalia on slide no. 15), 1♂ nymph, 6–8.xi.1981, NW/Centre Peak ridge, 1400–1500 m, 3♀, 1♂ nymph, 7–8.xi.1981; Bellenden Ker Range, Summit TV Stn., 1560 m, 1♀, 1–7.xi.1981, ½ km S of Cable Tower No. 7, 500 m, 2♂, 4♀, 1♂ and 2♀ nymphs, 17–24.x.1981, 1♀, 25–31.x.1981, Cableway Base Stn., 100 m, 1♂, 1♀ nymph, 17–



24.x.1981, Cable Tower 3, 1054 m, 1♂ nymph, 17-24.x.1981, 1♂ and 1♀ nymph, 25-31.x.1981. The following were collected by Monteith, Yeates, and Thompson, using pyrethrum knockdown: Mt. Edith, Lamb Range, 1000 m, 1♂, 12.x.1982; Emerald Cr., Lamb Range, 950 m, 2♂, 11.x.1982; 3.0 km west of Cape Tribulation (site 6), 500 m, RF, 1♂, 20.ix.-7.x.1982, 1♂ nymph, 2.x.1982; 4.5 km west of Cape Tribulation (site 9), 760 m, 1♂, 29.ix.1982. The following were collected by G. Monteith and D. Cook; Bakers Blue Mt., 17 km west of Mt. Molloy, 1100 m, RF, 1♀ nymph, 12.ix.1981; Mt. Lewis summit via Julatten, 1200 m, 1♂, 1♀ nymph, 9.ix.1981; Mt. Finnigan via Helenvale, 760-1000 m, 7♂, 1♀ nymph, 20-27.vii.1974; Bloomfield Road via Helenvale, above ABRS site 4, rain forest, 300-460 m, 1♂, 20-27.vii.1974; Thornton Peak via Daintree, 700-1000 m, rain forest, 1♀ nymph, 22.ix.1981. The following were collected by Monteith, Yeates, and Cook, some after pyrethrum knockdown: Mt. Finnigan, 37 km S of Cooktown, 850-1100 m, 2♂, 3♂ and 1♀ nymphs, 19-22.iv.1982; Black Mts., 17 km ESE of Julatten, 800-1000 m, 1♂, 1♀ nymph, 29-30.iv.1982, 4♂, 2♀ nymphs, 14.iv.1982; Mt. Fisher, 1050-1100 m, 7 km SW of Millaa Millaa, 1♂ (terminalia on slide no. 14), 2♂, 4♀, 1♀ nymph, 27-29.iv.1982; Windsor Tbl., NNW of Mt. Carbine, 1050 m, 2♂, 1♂ and 2♀ nymphs, 15-18.iv.1982, 35 km NNW of Mt. Carbine, 1050 m, 2♂, 1♂ nymph, 15-18.iv.1982, 1♀ and 1♂ nymphs, 25-26.iv.1982. UQLA: The following were collected by B. Cantrell; Palmerston Nat. Pk., via Innisfail, 1♂, 23.iv.1968; 8 miles east of Wallaman Falls, Ingham, 1♂, 3.i.1973; Mt. Lewis via Julatten, 3500 ft., 2♂, 1♀ nymph, 8.xii.1966, 1♀, 28.xii.1966; Millaa Millaa Falls via Millaa Millaa, 1♂, 10-11.xii.1966. The following were collected by G. Monteith; Belldenden Ker, 1♀, 7.viii.1966; Cooper Creek, 18 miles N of Daintree River, 1♀, 21-22.vi.1969; Henrietta Cr., Palmerston Nat. Pk., 1♀ nymph, 29.vii.1964; Paluma Dam, 2♂, 30-31.xii.1964 (labelled *Laxia* sp., by M.J. Mackerras); Lake Eacham, 1♂ nymph, 21.xii.1964; N. Qld (exact locality illegible), 1♀ nymph, 27.xii.1964.

DESCRIPTION

MALE: Interocular distance less than the length of the first antennal segment ($EAI = 0.5-0.9$) (Fig. 3C). Head with vertex and frontoclypeal region depressed, essentially smooth, genae not tuberculate (Fig. 3C). Pronotum with anterior and lateral margins not incrassated or strongly upturned, sparsely tuberculate, surface punctate (not granulate) (Fig. 3A), ventral surface practically smooth, without ridges on either side

of the hood. Abdominal tergites and sternites smooth. Supraanal plate broadly rounded (Fig. 1E), not quite reaching the hind margin of the subgenital plate. Subgenital plate weakly asymmetrical, hind margin rounded, lateral margins not distinctly indented (Figs. 1F, 3B). Ventral margins of femora armed with spines as follows: Front femur, anterior margin, 4-26 (often occupying the entire length of the margin, Fig. 3D), posterior margin, 0; Mid femur, anterior margin, 1-4, posterior, 0 (rarely 1); Hind femur, anterior margin, usually 2, sometimes 1 or 3, rarely 4, hind margin 0, sometimes 1. Genitalia as in Figs. 1G, 3E-H; L2d separated from L2vm; R2 with a subapical incision.

Colouration: Dark brown. Head with labrum brown, lower part of clypeus whitish, rest of face brownish black. Antennae brown with 2-4 white segments near the tip. Pronotum with anterior region pale, lateral zones reddish brown, medial hood and posterior region blackish brown, rarely reddish brown. Tegmina dark brown; wings infuscated. Abdominal tergites and sternites, and legs brown, subgenital plate reddish brown with yellowish spots along the right and left margins. Cerci pale dorsally and ventrally.

Measurements (mm): Body length, 13.5-16.5; pronotum length \times width, 4.1-5.1 \times 6.0-8.1; tegmen length, 15.1-19.5; interocular distance, 0.3-0.7; length of first antennal segment, 0.5-0.9.

FEMALE: Interocular distance about the same or slightly less than the length of the first antennal segment ($EAI = 0.7-1.1$). Head with vertex granulate, frons and genae rugulose. Dorsal surface of thorax and abdomen with large spaced tubercles, and dense granules; tubercles on abdominal tergites essentially arranged in 2 rows (Fig. 3I); lateral borders of the abdominal tergites not widely overlapping the edges of the sternites. Supraanal plate with sides parallel, hind margin weakly convex, not indented medially (Fig. 3I). Lateral regions of abdominal sternites not distinctly granulate, practically smooth. Anteroventral margin of front femur with 1-13 very small spines, often difficult to see (sometimes lacking spines), hind margin unarmed; mid and hind femora unarmed.

FIG. 3: *Neolaxia mackerrasae*, n. sp., from Queensland. A-H. Males, variant from Mt. Spurgeon: A. Pronotum; B. Subgenital plate and styles (ventral); C. Head (frontal); D. Front femur showing the spines on the anteroventral margin; E-G. Genital phallomeres L1, L2vm and L2d, and R2, respectively; H. Genital phallomere L2vm and L2d. I. Female paratype from Mt. Fisher, 7 km west of Millaa Millaa, habitus (dirt on the left half was removed). Figs. E-H are chitin preparations.

Colouration: Reddish and reddish brown, shiny; specimens are encrusted with dirt and have to be cleaned to reveal color and texture (Fig. 3I). Head reddish brown, clypeus and labrum yellowish. Disk of pronotum dark, shading to lighter red at the lateral borders, and with a pair of yellow spots on the anterior margin (Fig. 3I). Meso- and metanotum and abdominal tergites red with indications of a pair of broad dark longitudinal stripes on the right and left halves of the segments. Undersurface of thoracic segments reddish with yellow areas near the body margin, the pronotum showing the pair of yellow anterior spots that are visible from the dorsal surface. Abdominal sternites and legs red to reddish brown. Cerci dorsally and ventrally reddish or yellowish.

Measurements (mm): Body length, 17.0–21.0; pronotum length \times width, 4.7–6.4 \times 8.7–11.4; interocular distance, 0.7–0.8; length of first antennal segment, 0.7–1.0.

NYMPH: Both sexes resemble the adult female except that the surface granules are less distinct, and the base color is lighter so that the longitudinal bands are more obvious. Spines on the anteroventral margin of the front femur are often lacking.

VARIANT: Male specimens from Mt. Spurgeon differ in being larger on the average, and much lighter in colour. Spikes on ventral margins of the femora as follows: Front, anterior, 8–24, posterior, 0; Mid, anterior, 0–3, posterior, 0 (rarely 1); Hind, anterior, 0–1 (rarely 2), hind, 0.

Measurements (mm): Body length, 16.5–18.2; pronotum length \times width, 4.8–5.2 \times 7.7–8.3; tegmen length, 18.7–22.0; interocular distance, 0.3–0.5, length of first antennal segment, 0.8–0.9; EAI = 0.3–0.6.

Material examined: Queensland. MCZH: Mt. Spurgeon, 3500–4000 ft., 1♂ (wing on slide no. 216), 1♂ (terminalia on slide no. 89), 1♀ (terminalia on slide no. 90), 5♀, 26.vii.1932, 1♂, 28.vii.1932, Darlington, Australia Harvard Exped.

ETYMOLOGY

The species is named after the late Dr M. Josephine Mackerras.

REMARKS

The number of spines on the anteroventral margin of the front femur varies greatly in both sexes. Males never lack them completely and have as few as 4–8 in specimens from Mt. Fisher, and Ingham, whereas the numbers vary from 12–26 in other localities. In females the spines are reduced in size and number and are difficult to see. Females

and nymphs may lack the spines completely which explains why Mackerras labelled 2 females *Laxta* sp. These specimens and others with 'Laxta-type' femora are similar to females of *Neolaxta mackerrasae* from the same or nearby localities and I therefore consider them to be this species. However, it is possible that there is a species of *Laxta* whose females have the same color pattern as *N. mackerrasae*.

Neolaxta triangulifera n.sp (Figs 1H–J; 4A–D)

MATERIAL EXAMINED

HOLOTYPE: male, N.E. Qld., Nth. Bell Peak, 20 km S. Cairns, 900–1000 m, 15–16.ix.1981, G. Monteith and D. Cook, QM T.9561.

PARATYPES: QUEENSLAND. QM: Mt. Fisher, 7 km SW Millaa Millaa, N. Qld., QM. Berlesate No. 409, rainforest, 1100 m, sieved litter, 17.34S 145.34E, 1♂, 27.iv.1982, Monteith, Yeates, and Cook; Bellenden Ker Range, ½ km S. Cable Tower No. 7, 500 m, 1♀ nymph, 25–31.x.1981, Earthwatch/Qld. Museum. The following were collected by Monteith, Yeates and Thompson: 3.0 km W of Cape Tribulation (site 6), 500 m, RF, 1♀ (terminalia on slide no. 16), in baited fly trap, 20.iv.–7.x.1982; NE Qld., Bell Peak North, 10 km E Gordonvale, 850–1000 m, 1♂ (genitalia on slide no. 17), 13.x.1982. ANIC: The Crater Nat. Park, ESE of Herberton, Qld., in leaf litter, 2♀ nymphs, 25.i.1972, J.G. Brooks; 22 km S of Atherton, Longlands Gap Rd., leafmould, rain forest, 1♀ nymph, 11.xi.1969, J.G. Brooks.

DESCRIPTION

MALE: Region between the ocelli distinctly concavely excavated, eyes bulging, close together, the interocular distance less than the length of the first antennal segment (EAI = 0.4) (Fig. 4B). Pronotum subelliptical, margins not thickened, weakly upturned, surface punctate (not granulate), with only 4 small tubercles on the elevated hood portion, the two anterior ones closer together than the posterior pair; the punctations are pits each containing a minute seta (Fig. 4A). Supraanal plate transverse, hind margin produced medially as a small triangular lobe (Fig. 1H). Subgenital plate weakly asymmetrical, right side oblique, hind margin rounded, weakly reflexed dorsad (Fig. 1I). Ventral margins of the femora armed as follows: Front femur, anterior margin, 2–4, posterior margin, 0; Mid femur, front, 4–6, hind 1–2; Hind femur, front, 3–4, posterior, 1–2. Genitalia as in Fig. 1J; L2d attached to apex of L2vm; R2 without a subapical incision.

Colouration: Light brown. Region between eyes and ocelli dark brown, rest of face yellowish. Pronotum with hood and mid posterior region

somewhat darker than the lateral and anterior parts; punctations partly pigmented, half-moon-shaped. Tegmina light brown, hyaline. Abdominal tergites, sternites, and legs, light brown. (The male paratype is lighter in color than the holotype).

Measurements (mm): Body length, 14.0–14.8; pronotum length \times width, 5.0×7.6 – 8.5 ; tegmen length, 17.0–17.5; interocular distance, 0.2; length of first antennal segment, 0.5.

FEMALE: Very flat, covered with a thin layer of dirt which has to be removed to see color and surface texture. Head smooth, vertex flat, interocular space about the same as the length of the first antennal segment ($EAI = 0.9$ – 1.0) (Fig. 4D). Pronotum (Fig. 4C) with anteromedial

margin weakly indented, tubercles very sparse, a few restricted to the hood and along the hind margin, remaining surface practically non-granulate, some small dark specks (each indicating the position of a minute seta) may be slightly raised above the surface. Abdominal tergites with small, widely spaced tubercles along their hind margins, remaining surfaces non-granulate, lateral margins widely overlapping the edges of the sternites. Hind margin of supraanal plate undulate, the right and left sides deeply concave forming 3 lobes (a medial and 2 lateral) (Fig. 4C). Front leg with minute dark granules on the anterior face of the coxa, and ventral surfaces of the trochanter and femur, some of the granules also occurring on the lower anterior

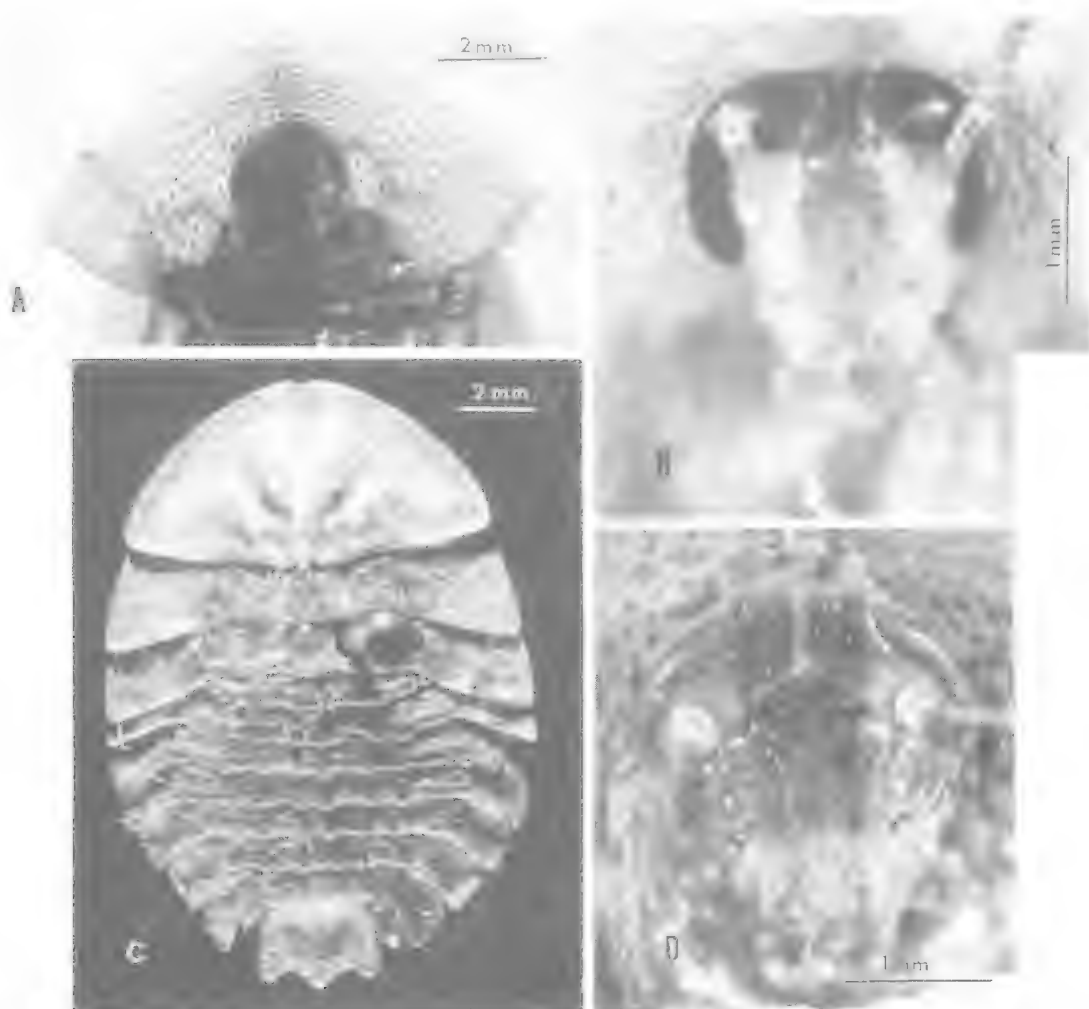


FIG. 4: *Neolaxta triangulifera*, n. sp., from Queensland. A. Male holotype from Nth. Bell Peak, pronotum. B. Male paratype from 3 km west of Cape Tribulation, head (frontal). C, D. Female paratype from Mt. Fisher, 7 km southwest of Millaa Millaa, habitus, and head (frontal), respectively.

surface of the femur. Spines on the ventral margins of the femora are as follows: Front femur, anterior margin, 0-1, hind margin, 0; Mid femur, anterior, 0-4, posterior, 0-2; Hind femur, anterior 0-3, posterior, 0-2.

Colouration: Light brown. Head with a dark brown spot on the frons and between the eyes, the latter divided by the Y-shaped suture. Dorsal surface brown, with lighter broad lateral zones. Pronotum with dark specks, each spot indicating the site of a minute seta. Abdominal sternites light brown, speckled with small brown spots. Cerci dark brown with yellow apices.

Measurements (mm). Body length, 14.6-17.0; pronotum length \times width, 4.3-5.4 \times 9.0-10.2; interocular distance, 0.8-0.9; length of first antennal segment, 0.9-1.0.

NYPH: Both sexes resemble the adult female, but lack the minute dark granules on the front coxa, trochanter, and femur. Spines on the ventral margins of the femora are lacking.

ETYMOLOGY

The specific name refers to the median triangular lobe on the hind margin of the supraanal plate.

REMARKS

As in *mackerrasae*, the small number and size of the spines on the ventral margins of the femora, or their complete absence, makes it difficult to place the females and nymphs in *Neolaxta*. However, the shape of the supraanal plate (both sexes) is unique for the species and makes it easily identifiable.

Neolaxta sp. A.

MATERIAL EXAMINED

QUEENSLAND, ANIC: Bluff Ra. near Biggenden, foothills under leaf mould, 1♀ (possibly a nymph), 16.viii.1971, H. Frauca.

DESCRIPTION

FEMALE. Similar to *triangulifera*, but differs as follows: Supraanal plate shorter, the hind margin between the rounded posterior corners weakly

scalloped, lacking a distinct medial triangular lobe. Pro-, meso-, and metanotum with a longitudinal row of upright tubercles on each side of the midline; in addition, the pronotum has groups of tubercles on the outer borders of the cucullus. The tubercles along the hind margins of the abdominal tergites are upright and each segment has a median tubercle forming a longitudinal line that is a continuation of the medial double row of thoracic tubercles. The spines on the anteroventral margin of the front femur are only slightly more robust than the hairs on the mid and hind femora, and they are not characteristic for the genus. The ventral surface of the trochanter and femur of the front leg lack granules.

Colouration: The surface is covered with debris which has to be removed to reveal color and texture. Light brown. Head with frons and vertex dark brown. Pronotum with 4 dark spots on the lateral parts of the hood where groups of tubercles are located. A dark brown median line, delineated by upright tubercles, starts at about the center of the pronotum and continues the length of the meso- and metanotum.

Measurements (mm): Body length, 13.2; pronotum length \times width, 4.5 \times 8.0; interocular distance, 1.0; length of first antennal segment, 0.8.

REMARKS

Although this specimen appears to be distinct from the more northern *triangulifera*, I feel it should not be named until the male is found.

ACKNOWLEDGEMENTS

I thank the museums and curators, mentioned earlier, who kindly lent me specimens. I am grateful to the American Philosophical Society (Penrose Fund), and the Australian Biological Resources Study (ABRS), for partial support.

LITERATURE CITED

MACKERRAS, M.J., 1968. *Neolaxta monteithi*, gen. et sp. n., from eastern Australia (Blattodea : Blaberidae). *Jour. Aust. Entomol. Soc.* 7: 143-6.

THE GENUS *TRYONICUS* SHAW FROM AUSTRALIA AND NEW CALEDONIA
(DICTYOPTERA : BLATTARIA : BLATTIDAE : TRYONICINAE).

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ABSTRACT

The genus *Tryonicus*, which was previously known from one species, *T. parvus* (Tepper), in southeastern Australia is revised. Two new species, *T. monteithi* and *T. mackerrasae* are described from north Queensland. The genus is newly recognized from New Caledonia by the transfer of three species of *Stylopyga* to *Tryonicus*, viz. *T. angusta* Chopard, *T. rufescens* Chopard, and *T. vicina* Chopard. *Tryonicus* is redefined, its subfamily position is discussed, and a key is presented to both sexes of the six included species.

INTRODUCTION

The material on which this paper is based was loaned to me by the following museums and curators: ANIC — Australian National Insect Collection, CSIRO, Canberra, A.C.T., Australia; Dr D.C.F. Rentz and Mr John Balderson; MCZH — Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A.; Dr A.F. Newton; MHNH — Naturhistorisches Museum, Basel, Switzerland; Dr C. Baroni Urbani; QMBA — Queensland Museum, Brisbane, Australia; Dr G.B. Monteith; UQLA — University of Queensland, St. Lucia, Brisbane, Australia; Miss M. Schneider through Dr G.B. Monteith.

Genus *Tryonicus* Shaw

Tryonicus Shaw, 1925, p. 202; McKittrick and Mackerras, 1965, p. 224; Mackerras, 1968, p. 556. Type-species: *Tryonicus montanus* Shaw [synonym of *Tryonicus parvus* (Tepper)], by monotypy, Princis, 1966, p. 559.

REMARKS

Species of *Tryonicus* are found, at reasonable altitudes, on the ground under stones and bits of wood in wet rain forest. They are never found under bark or above ground on dead trees or logs like most other rainforest cockroaches (Monteith, pers. comm.).

AFFINITIES

McKittrick and Mackerras (1965) established the Tryonicinae and placed it between the

Lamproblattinae and Blattinae in the Blattidae. However, Princis (1966, p. 404) did not accept the Lamproblattinae or Tryonicinae, and synonymized both with Blattinae. Shaw (1925, p. 202) had earlier suggested that the genus be placed in the *Blatta* group of the Blattinae.

McKittrick and Mackerras (1965, p. 227) compared the spermathecae of *Lamproblatta albipalpus* (Lamproblattinae), *Blatta orientalis* (Blattinae), and *Eurycotis floridana* (Polyzosteriinae). According to them, the spermatheca of *Tryonicus parvus* (= *montanus*) is forked and one branch bears a round sclerotized, terminal expansion, whereas the other is wholly membranous, but is thicker than the common duct (Fig. 2L). When sclerotizations occur in spermathecae of the other species, supposedly they are elongate rather than round. Unfortunately these comparisons are based only on one species representing each of the subfamilies. *Tryonicus mackerrasae* n. sp. and *T. monteithi* n. sp. have unbranched spermathecae whose sclerotized reservoirs are elongate and straight (Fig. 6B, J), or elliptical or round (Figs. 3H, I, 6C, E, H). *Tryonicus* sp. J has a forked spermatheca but the small branch is about the same width as the common duct (Fig. 7E, G). The most unusual spermatheca occurs in *Tryonicus angusta* which has a reservoir that terminates in a sphere at one end and a club-shaped extension at the other (Fig. 8G). Although the spermathecae are variable, I believe that the other characters given by Mackerras (1968, pp. 513, 556) warrant retaining the subfamily Tryonicinae.

The oothecae of the Lamproblattinae differ markedly from those of the Blattinae and Polyzosteriinae, both of which have similar egg cases. A comparison of the oothecae of species of *Tryonicus* with those of related subfamilies might aid in placing the genus more unequivocally (Roth 1968, p. 87). Mackerras (1968, p. 560) unsuccessfully tried to rear *T. parvus* but never obtained oothecae. I have seen one pinned female of *T. monteithi* which had started to make an ootheca, but not enough had been formed in the genital chamber to indicate the final shape of the keel, and nature of the lateral walls. However, the fragment suggested that the shape of the keel and walls are different from those of the Blattinae and Polyzosteriinae; the walls of the fragment contained masses of calcium oxalate crystals, which is characteristic of all Blattidae. Shaw (1925, p. 191) stated that the ootheca is not longitudinally fluted.

T. mackerrasae, *T. monteithi*, and *T. sp. 1* are more closely related to each other (T1 modified, and similarity in left male genital phallomere), than they are to either *T. parvus* and *T. angusta*. Male genitalia of *T. rufescens* and *T. vicina* were not available for comparison. The male genitalia and female spermathecae of the new Australian taxa are variable suggesting that these species are in a state of flux.

DIAGNOSIS

Eyes reduced, distance between them greater than that between antennal sockets, ocellar spots absent. Last maxillary palpal segment enlarged (Figs 2F, 3E, 4G). Male tegmina reduced in length, either narrow lateral pads (P1. 1A), or broad (normal width) with overlapping hind margins (P1. 1C, E), or completely absent (Fig. 8A); wings vestigial, much smaller than and hidden under the tegmina (Figs 2A, 4A), or absent (Fig. 8A). Female completely apterous (P1. 1B), or with small lateral tegmina and hind wings absent (P1. 1D, F). Ventral margins of femora armed as follows: Front femur: anterior margin with a few slender setae on basal half followed by a row of very small piliform setae, terminating in 1 or 2 large distal spines, posterior margin with 0-1 spines plus 1 distal, or completely unarmed; Mid femur: anterior margin, 0 plus 1 distal, or completely unarmed, posterior margin unarmed or, 0-2 plus 1 distal; Hind femur: anterior margin, 0 plus 1 distal, posterior margin, usually 1-3 (0 or 4-6 rare), plus 1 distal, or with 2 spines without a distal; geniculate spine on mid and hind femora, absent from front femur. Pulvilli small and apical,

or not clearly present on all segments, or completely absent; arolia absent (Mackerras stated that arolia are 'small or absent', but I have not seen this structure on any specimens; in her description of *T. parvus*, on which the generic description was based, she stated that arolia are absent, as was pointed out by Shaw); tarsal claws long, symmetrical, simple. First abdominal tergite (3) with (P1. 1C), or without a medial specialization; female abdominal tergites unspecialized. Male subgenital plate symmetrical or practically so, styles similar, small, cylindrical, widely separated (Fig. 2D). Spermatheca with a long convoluted duct, the terminal region forked (Figs 2L, 7E, G), or unbranched, the enlarged reservoir straight (Fig. 6B), or with an elliptical (Fig. 6C) or round enlargement (Fig. 3H), or with both an elliptical or round swelling (Fig. 8G). Basivalvulae of female genitalia fused with the spermathecal plate forming a single strong sclerite surrounding the spermathecal opening (Fig. 6A). Male genital phallomere L2v may be intraspecifically variable (Fig. 5A-D). Proventriculus as in Fig. 6G.

KEY TO SPECIES OF *TRYONICUS**

1. Males 2
Females 7
2. Tegmina present 3
Tegmina absent (New Caledonia) *angusta*
3. Tegmina reduced to widely separated, narrow lateral pads which extend only to about the hind margin of the mesonotum or metanotum. Hind wings present (vestigial) or absent 4
Tegmina reduced in length reaching to about hind margin of T2, or middle of T3, their widths normal with hind margins overlapping at midline (P1. 1C, E). First abdominal tergite with a median specialization 5
4. Tegmina short reaching to about hind margin of mesonotum. Hind wings absent 6
Tegmina longer, extending slightly beyond hind margin of metanotum (P1. 1, A). Hind wings very narrow (Fig. 2A), hidden under tegmina. First abdominal tergite unspecialized. (Australia) *parvus*
5. Small (pronotum length \times width, 2.0-2.6 \times 2.8-3.1; tegmen length, 2.2-3.0). Yellowish brown, palps pale. Hind margin of supraanal

*The male of *Tryonicus* sp. 1 keys out to couplet 5 (see remarks under that species)

plate concavely excavated (Fig. 3G).

(Australia) *mackerrasae*

Larger (pronotum length \times width, 3.2–4.3 \times 4.0–5.5; tegmen length, 3.1–4.5). Blackish or dark brown (tegmina may have a metallic sheen), palps dark. Hind margin of supraanal plate convexly rounded (Fig. 4D), or with a weak medial indentation (Fig. 4B).

(Australia) *monteithi*

6. Tegmina with anterior (outer) margin straight, posterior (inner) border convex, apex truncate. (New Caledonia).....*rufescens*

Tegmina narrower, tapering to an acute or subacute apex. (New Caledonia) *vicina*

7. Tegmina and wings absent (P1. 1,B) 8
Tegmina reduced to small lateral pads (P1. 1,D,F), wings absent 9

8. Hind margin of T7 sinuous (Fig. 2E).
(Australia)*parvus*

Hind margin of T7 straight (Fig. 8A). (New Caledonia).....*angusta*

9. Tegmina very narrow, tapering to an acute or subacute apex. (New Caledonia) *vicina*
Tegmina slightly wider, apically truncate or subtruncate 10

10. Blackish or blackish brown; head, antennae, and palps dark brown. Pronotum length \times width, 3.0–4.0 \times 3.9–4.9; tegmen length \times width, 1.0–2.0 \times 1.2–1.7. (Australia) . . .
..... *monteithi*

Coloration not as above..... 11

11. Reddish brown; head blackish brown, antennae and palps pale yellowish. Pronotum length \times width, 2.6 \times 4.0; tegmen length \times width, 1.7 \times 0.8. (New Caledonia).....
.....*rufescens*

Yellowish brown; head not darker than rest of body; palps pale, antennae slightly darker. Pronotum length \times width, 2.0–2.3 \times 2.9–3.3; tegmen length \times width, 0.7–1.0 \times 0.8–0.9.

(Australia) *mackerrasae*

DISTRIBUTION

Of the three species of *Tryonicus* known from Australia, *T. parvus* is the most southern and was previously known from eastern New South Wales, and Lamington National Park in southeastern Queensland near the New South Wales border (Mackerras 1968). New records extend the range 800 km north to Eungella, central Queensland. *T. mackerrasae*, *T. monteithi* and *T. sp. 1* occur in

mountains of the wet tropical zone of north Queensland. *T. mackerrasae* is most widespread, extending from the Kirrama Range north to Cape Tribulation. The other two have smaller ranges within the same zone and all three are sympatric in the mountains behind Mossman (Fig. 1).

Before *Tryonicus* was recognized from New Caledonia, Dr G.B. Monteith wrote me (June 7, 1984) that 'The reason I went to New Caledonia (an old Gondwana plate fragment with many ancient biogeographic links with Australia) was to investigate the summit faunas of some of its mountains. One of the montane relicts I suspected



FIG. 1: Distribution of species of *Tryonicus* in Australia.

might be there was *Tryonicus* and I was delighted to confirm this'. There are many examples of links between primitive elements of the Australian flora and fauna and that of New Caledonia (c.g. Holloway 1979; Monteith 1980). The new Caledonia species all occur above 600 m altitude. *T. angusta* is widespread over the northern two-thirds of the island, but *T. rufescens* and *T. vicina* are still known only from their type localities at Mt Ignambi and Mt Humboldt, respectively at the north and south ends of the island.

***Tryonicus parvus* (Tepper)**
(Figs 2A-L, Plate 1A, B)

Periplaneta parva Tepper, 1895, p. 162 (female).

Blatta parva (Tepper), Kirby, 1910, p. 564.

Platyzoisteria parva (Tepper), Shelford, 1910, p. 7 (as doubtful species).

Cutilia parva (Tepper), Shaw, 1925, p. 191.

Melanozosteria parva (Tepper), Princis, 1966, p. 576.

Tryonicus parvus (Tepper), Mackerras, 1968, p. 557, figs 50-57, 58, 98, 99, 103 (male and female).

Tryonicus montanus Shaw, 1925, p. 202, figs 24-26;

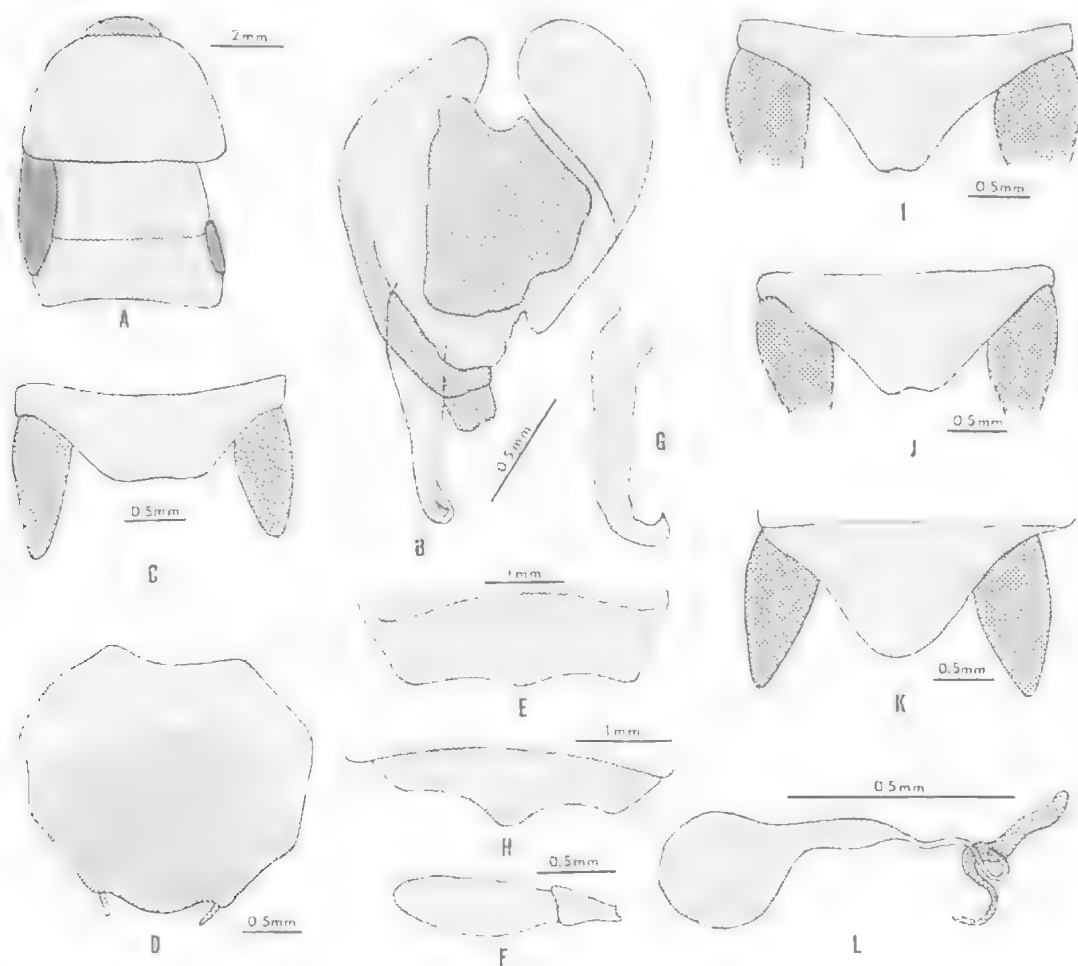


FIG. 2: *Tryonicus parvus* (Tepper). A-G, Male: A, Thorax (right tegmen removed to show small hind wing); B, Left genital phallomere; C, Supraanal plate; D, Subgenital plate; E, Seventh abdominal tergite; F, Maxillary palpal segments 4 and 5; G, Genital phallomere L3; H, Nymph, seventh abdominal tergite. I-L, Females: I-K, Supraanal plates; L, Terminal portion of spermatheca. Localities: A-E, H, Bald Mt. area, Qld.; F, Gibraltar Range, via Glenn Innes, N.S.W.; G, Lamington National Park, Qld.; I, Barrington House, N.S.W.; J, Eungella Nat. Park, Qld.; K, L, National Park, McPherson Range, Qld.

McKittrick and Mackerras, 1965, p. 224, figs 2, 9a, 9b, 10; Mackerras, 1968, p. 557; Princis, 1966, p. 559.

MATERIAL EXAMINED

The holotype was not examined; it is a ♀, from Sydney, N.S.W. and is in the South Australian Museum.

QUEENSLAND. QMBA: National Park, Q., Macpherson Ra., ♂ holotype of *Tryonicus montanus* Shaw (no. 0/2872); (labelled *montana*), xii.1918, (additional data from Shaw, 1925, p. 203; Lamington Plateau, 3000 ft, 1917–1918); National Park, Lamington, Q., 2♀ paratypes of *Tryonicus montanus* Shaw (genitalia of one mounted between coverslips by M.J. Mackerras), 3000 ft., i.1917, H. Tryon; same locality and elevation, 1♀ paratype of *T. montanus*, i.iii.1921, A.J. Turner. UQLA: Eungella Nat. Pk., via Mackay, N.Q., 1♀ (slide 10), 5.viii.1968, B. Cantrell; Conondale, sites 12–13, 1♀, 29.xi.1974, G.B. Monteith; Lamington Nat. Pk., S.E. Qld., *Nothofagus* forest, 3800 ft, 1♂ (slide 8), 1 nymph, 30.i.1965, G. Monteith; Bald Mt. area, via Emu Vale, SE. Qld., 3–4000 ft., 17–22.v.1969, 1♂ (slide 12), B. Cantrell, 2♂, 1 nymph, G.B. Monteith; no data, 1♂ (genitalia mounted between coverslips by M.J. Mackerras). MCZH: Nat. Park, Q., McPherson Rge., 3–4000 ft., 1♀, March 1932, Darlington. ANIC: Lamington N.P., 1♂ (genitalia between coverslips on pin), 1 nymph (ex colony 212, 1.v.1965 (both det. as *parvus* by Mackerras).

NEW SOUTH WALES. UQLA: Barrington House, via Salisbury, 1♀ (slide 9), 26–28.xii.1965, T. Weir. The following were collected by G. Monteith: Carrai Plateau, via Kempsey, 1♂, 3–5.i.1967; Gibraltar Range, via Glen Innes, rain forest, 3♂, 27–29.xii.1972; Night Cap Track, Whian Whian S.F., via Dunoon, 1 nymph, 25.xi.1972. (1♂ retained at MCZ). ANIC: Ebor, 1♀ (genitalia between coverslips on pin), 21.iii.1954, E.F. Riek (det. as *parvus* by Mackerras).

DESCRIPTION

Mackerras (1968, p. 557) gave a complete description of *parvus*. The following should distinguish this species from the new taxa.

MALE. Tegmina greatly reduced to narrow, widely separated lateral pads extending slightly beyond hind margin of metanotum; wings much smaller, narrow, elongated, completely hidden under tegmina (Figs 2A, Pl. 1A). First abdominal tergite unspecialized. Hind margin of seventh abdominal tergite sinuous (Fig. 2E). Supraanal plate transverse, hind margin almost straight (Fig. 2C), or weakly convex. Interstyler margin of subgenital plate convex (Fig. 2D). Left genital phallomere as in Fig. 2B. Anteroventral margin of front femur with 2 distal spines, posterior margin with 1 distal; Mid femur, anteroventral margin, O plus 1 distal, posteroventral, 0–2 plus 1 distal; Hind femur, anteroventral with 0 plus 1 distal, posteroventral, usually 2 or 3 (rarely 0, or 4–6)

spines plus 1 distal. Pulvilli small, apical. Mainly black, shining. Antennae with a few pale segments in the middle third.

FEMALE. Apterous (Pl. 1B). Supraanal plate trigonal, apex rounded (Fig. 2K), or weakly (2I) or more distinctly indented (Fig. 2J). Spermathecal reservoir round, bulbous, arising from the long convoluted duct preapically, the region beyond the insertion wider than the long duct (Fig. 2L).

MEASUREMENTS (mm) (♀ in parentheses). Body length, 12.0–14.0 (11.0–16.7); pronotum length × width, 3.2–3.8 × 4.7–5.8 (3.2–3.7 × 4.8–5.3); tegmen length × width, 2.7–3.5 × 1.2–1.7.

NYMPH. Resembles adult female but hind margin of seventh abdominal tergite is more deeply sinuous (Fig. 2H).

Tryonicus mackerrasae, n. sp. (Figs 3A–I, Plate 1, C, D)

Tryonicus n. sp. A and B, Mackerras, 1968, p. 561. (female).

MATERIAL EXAMINED

HOLOTYPE: ♂, Kiramma State Forest, via Cardwell, N. Qld., 17–18.viii.1966, G. Monteith (labelled *Tryonicus* sp. nov., by Mackerras); in the QMBA (T.9526).

PARATYPES: Queensland. UQLA: Crater Lake Nat. Park, via Ravenshoe, N.Q., 1♂ (slide 7), 1♂ (slide 13), 2♂, 1♀ (slide 14), 1♀ (slide 15), 3♀, 9.viii.1968, B. Cantrell (1♂ and 1♀ retained in MCZ); Millaa Millaa Falls, via Millaa Millaa, N.Q., 1♂, 10–11.xii.1966, B. Cantrell; same data as holotype, 1♀ (slide 17); Mt. Edith, 2 ml. N. of Tinaroo Dam, N.Q., 3500 ft., 1♀, 2.vi.1972, G.B. Monteith. QMBA: Bellenden Ker, Cableway Tower No. 3, 1000 m, Pyrethrum/trees, 1♀, 25.ix.1981, G. Monteith; Bellenden Ker Range, N.Q., Cable Tower No. 3, 1054 m, 1♂ (slide 39), 25–31.x.1981, Earthwatch/Qld Mus.; Mt. Fisher, 7 km SW Millaa Millaa, N.Q., Kjellberg Rd., 1000 m, 1♂ (slide 32), 4♂, 1♀, 1♂ (slide 33), 3.v.1983, G.B. Monteith and D.K. Yeates; The Bluff, 11 km W. of Mossman, N.E. Qld., 800–1300 m, 1♂ (slide 24), 2.xi.1983, Monteith, Yeates, and Thompson; 4.5 km W. of Cape Tribulation (site 9), 760 m, Pyrethrum knockdown, R.F., 1♂, 29.ix.1982, Monteith, Yeates, and Thompson; Mt. Demi, 7 km S.W. of Mossman, N.E. Qld., 1100 m, 1♂ (slide 29), 29.x.1983, D.K. Yeates and G.I. Thompson; 21 km S. of Atherton, N.E. Qld., 1040–1100 m, Pyrethrum knockdown in R.F., 1♂, 5.xi.1983, D.K. Yeates and G.I. Thompson. ANIC: 'Dunbulla' (= Danbulla), 2♂, 30.vi.1951, J.F. Gay (sp. A of Mackerras).

DESCRIPTION

MALE. Tegmina reduced in length reaching to about hind margin of T2, or middle of T3, normal in width, hind margins overlapping; hind wings much smaller, folded, curved, apices directed

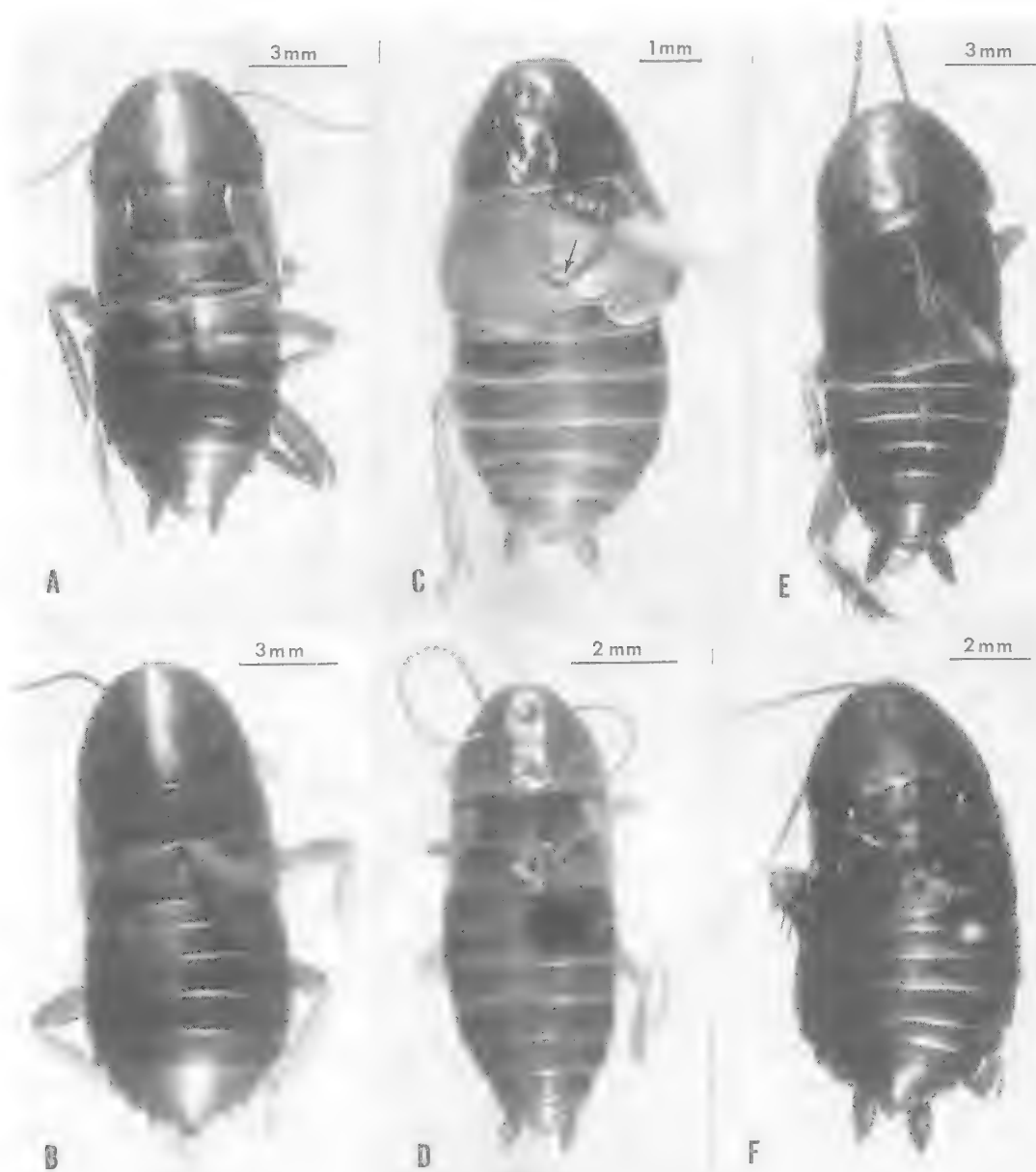


PLATE 1. *Tryonicus* spp., habitus of males (upper row) and females (lower row). A, B, *T. parvus* (Tepper) (A from Gibraltar Range, via Glenn Innes, N.S.W.; B, from Conondale, Qld); C, D, *T. mackerrasae*, n. sp., male holotype and female paratype (both from Kirrama State Forest, Qld); E, F, *T. monteithi*, n. sp., male holotype (Bellenden Ker Range, Qld), and female paratype (Bartle Frere, NW Centre Peak). Arrow in Fig. C indicates position of gland on T1.

toward midline of abdomen where their tips almost touch setal specialization on T1 (Figs 3A, Pl. 1C). First abdominal tergite with dense setal tuft directed dorsally or dorsoposteriorly located in anteromedial fossa (Figs 3A, Pl. 1C), and partly hidden under metanotum. Hind margin of T7 straight. Supraanal plate transverse, lateral margins oblique, corners rounded, hind margin shallowly concave medially (Fig. 3C). Subgenital plate short, extending slightly beyond hind margin of supraanal plate, interstyler margin truncate or practically so (Fig. 3D). Front femur:

anteroventral margin with row of slender setae on basal half followed by row of very small piliform setae, terminating in 1 distal spine, posteroventral margin with single distal spine; Mid femur: anteroventral margin with 1 distal, posteroventral margin unarmed, or sometimes with 2 small spines, 1 distal spine present; Hind femur: anteroventral margin with 1 distal spine, posteroventral margin with 1 or usually 2 spines, plus 1 distal; genicular spine on mid and hind femurs. Arolia and pulvilli absent. Left genital phallomere as in Fig. 3B.

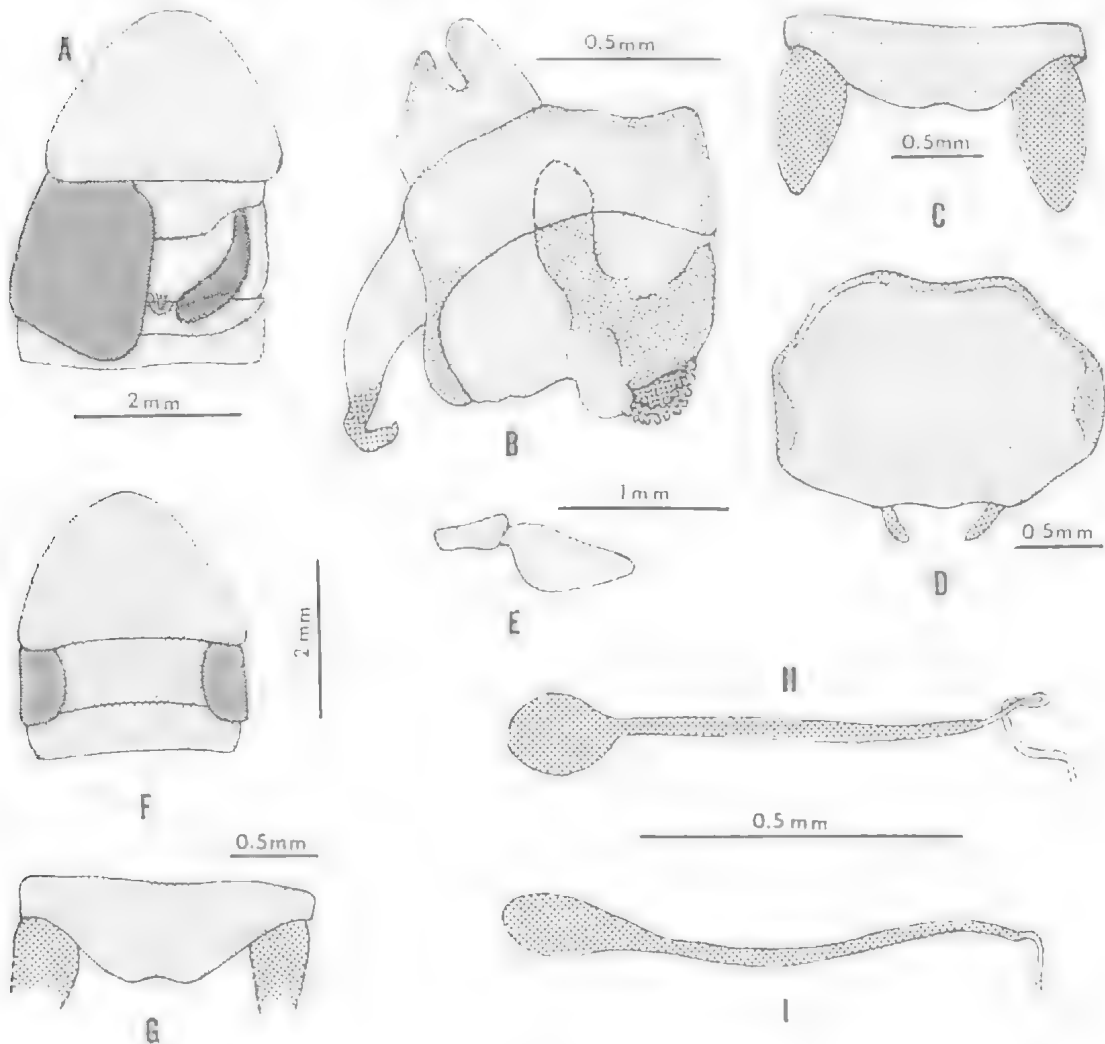


FIG. 3: *Tryonicus mackerrasae* n. sp. A-E, Males: A, Holotype, thorax (right tegmen removed to show hind wing); B-D, Paratype from Mt. Demi, 7 km SW of Mossman, Qld.; B, Left genital phallomere; C, Supraanal plate; D, Subgenital plate; E, Holotype, maxillary palpal segments 4 and 5. F-I, Female paratypes: F, Thorax (Mt. Edith, Qld.); G, H, Supraanal plate and terminal part of spermatheca (Mt. Fisher, 7 km SW of Millaa Millaa, Qld.); I, Terminal part of spermatheca (Kirrama State Forest, Qld.).

Coloration. Head reddish brown, palps and basal part of clypeus yellowish, labrum brownish yellow. Antennae light brown, without pale segments. Pronotum brown, lateral regions more broadly pale than anterior or posterior zones. Tegmina, abdominal tergites, and cerci, brownish, darker than paler legs and abdominal sternites.

FEMALE. Tegmina widely separated, small lateral pads, posterior margins convex, apices truncate reaching (and a continuation of) hind margin of mesonotum, or sometimes slightly beyond (Figs 3F, Pl. 1, D); hind wings absent. Supraanal plate transverse, hind margin usually with a shallow mesal invagination (Fig. 3G), or sometimes narrowly truncate. Genital sclerites typical of the genus. Spermatheca unbranched with a round or elliptical reservoir at apex (Fig. 3H, I).

MEASUREMENTS (mm) (♀ in parentheses). Body length, 6.0–9.2 (6.3–8.4); pronotum length × width, 2.0–2.6 × 2.8–3.1 (2.0–2.3 × 2.9–3.3); tegmen length × width, 2.2–3.0 × 1.7–2.3 (0.7–1.0 × 0.8–0.9).

REMARKS

Mackerras (1968, p. 561) claimed to have 2 new species of *Tryonicus* which she did not name. Species A was represented by 2 small yellowish females taken at 'Dunbulla', Qld. (actually Danbulla), and have small lobiform tegmina. Species B was represented by a male and female which were small, yellowish brown, with pale yellow legs and palps, collected in Kirrama State Forest. These latter two specimens are the holotype and a paratype of the present species which I am dedicating to Dr Mackerras. According to her, the female is apterous, but it has small tegmina (Pl. 1D); she may have erred because the hind margins of the tegmina appear to be a continuation of the hind margin of the mesonotum. I have examined the specimens of her sp. A and they are both *mackerrasae*.

Tryonicus monteithi n. sp.

(Figs 4A–G, 5A–D, 6A–I, Plate 1E, F)

MATERIAL EXAMINED

HOLOTYPE: ♂, Bellenden Ker Range, N.Q., Summit TV Stn., 1560 m, 29.iv.–2.v.1983, G.B. Monteith and D.K. Yeates; in the QMBA (T.9540).

PARATYPES: Queensland. UQLA: Mt. Edith, 2 miles N. of Tinaroo Dam, N.Q., 1♂, 1♀ (slide 16), 2.vi.1972,

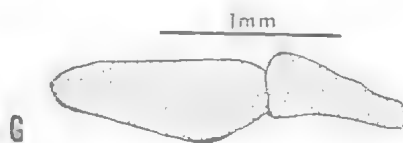
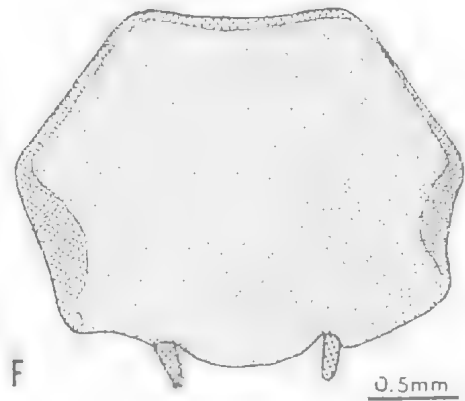
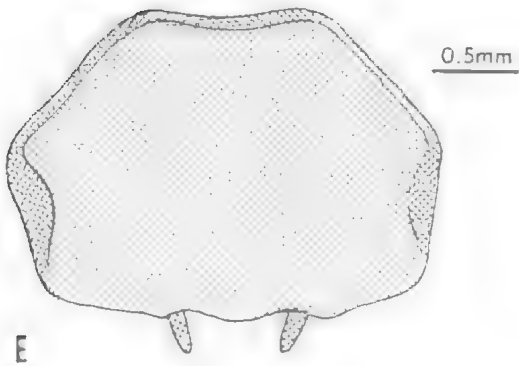
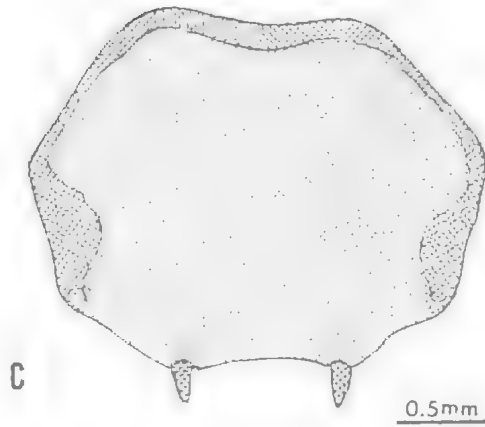
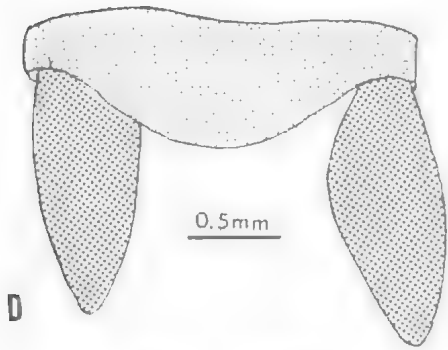
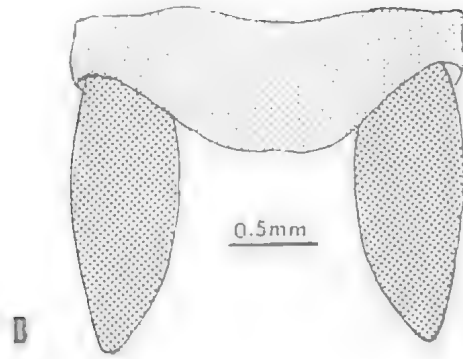
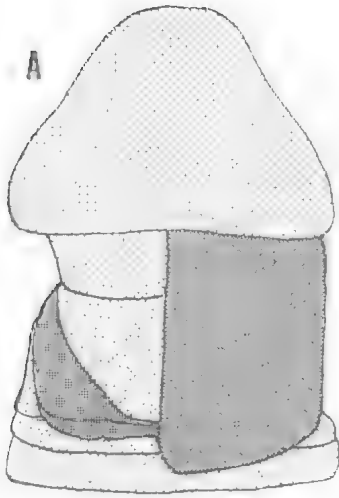
G.B. Monteith. QMBA: Mt. Bellenden Ker, Centre Peak Summit, 1500 m, 1♂ (slide 26), 1♀ (slide 30), 1♀ (slide 34), 10–12.iv.1979, G.B. Monteith; The Bluff, 11 km W. of Mossman, 1300 m, 1♂ (slide 27), 2.xi.1983, Monteith, Yeates, and Thompson; same locality as holotype, 1♀, 28.x.1983, Monteith, Yeates and Thompson, 1♂ (deposited in MCZ), 1♂ (slide 36) 2♂ (R.F., pitfall trap), 29.iv.–2.v.1983, G.B. Monteith and D.K. Yeates, 1♂ (R.F., pitfall trap), Apr.–Oct. 1982, S. Montague. The following were collected by Earthwatch/Qld. Mus.: same data as holotype, 1♀ (slide 25), 25–31.x.1981; Mt. Bartle-Frere, N.W. Centre Peak ridge, 1400–1500 m, 2♂, 1♀, 7–8.xi.1981; Mt. Bartle-Frere, Sth. Peak summit, 1620 m, 2♀ (one deposited in MCZ), 6–8.xi.1981; Bellenden Ker Range, Cable Tower 3, 1054 m, pitfall trap in rain forest, 1♂ (slide 35), 1♂ (slide 37), 1.xi.1981. The following were collected by G.B. Monteith and D. Cook: Bartle Frere, N.W. Centre Peak, 1400–1500 m, 1♂ (slide 22), 1♂, 1♀ (slide 23), 24.ix.1981; Nth. Bell Peak, 20 km S. Cairns, 900–1000 m, 1♂, 15–16.ix.1981.

DESCRIPTION

MALE. Tegmina reduced in length, reaching almost to hind margin of T2 or middle of T3, width normal, hind margins overlapping along midline of abdomen (Pl. 1E); hind wings further reduced, curved, apices directed toward median specialization on T1 (Fig. 4A). First abdominal specialization a tuft of setae in an anteromedial fossa or depression. Supraanal plate convexly rounded (Fig. 4D), sometimes with a weak indication of a broad medial indentation (Fig. 4B). Interstyler margin weakly convex (Fig. 4E, F), or subtruncate (Fig. 4C). Front femur: anteroventral margin with long slender setae on basal half, followed by row of short piliform setae, and 1 or rarely 2 distal spines, posterior margin with 1 distal spine; Mid femur: anteroventral margin with 1 distal, posteroventral with 1 or 2 spines plus 1 distal; Hind femur: anteroventral margin with 1 distal, posteroventral with 1, 2, or rarely 3 spines plus 1 distal; genicular spine on mid and hind femurs. Arolia and pulvilli absent. Terminal portion of L2v sclerite of left genital phallomere variable (Fig. 5A–D).

Coloration. Head black. Antennae may have some pale distal segments. Labrum reddish brown, basal half of clypeus yellowish, maxillary palps dark brown. Pronotum and tegmina black or brownish black very narrow lateral edges of former, and anterior margins of latter may be reddish brown, and the tegmina may have a

FIG. 4: *Tryonicus monteithi* n. sp., male paratypes from Queensland. A, Thorax (left tegmen removed to show reduced hind wing); B–F, Supraanal plate (with cerci) and subgenital plate (with styles); G, Segments 4 and 5 of maxillary palps. Localities: A, Mt. Bartle Frere; B and C, Bartle Frere, NW to Centre Peak; D and E, Bellenden Ker Range, Cable Tower 3; F and G, Bellenden Ker Range, Summit TV station.



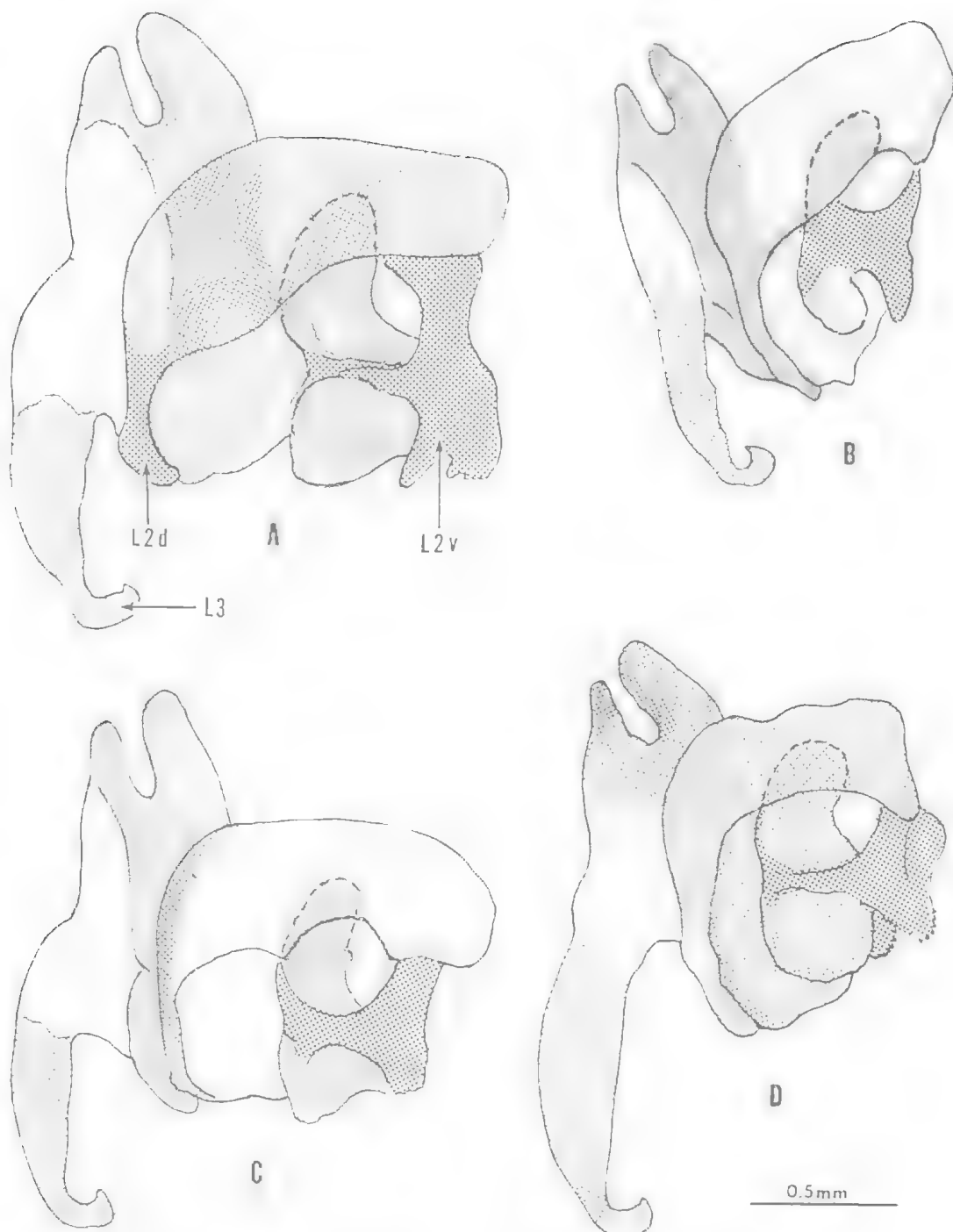


FIG. 5: *Tryonicus monteithi* n. sp., male paratypes from Queensland, left genital phallomeres. Localities: A-C, Bellenden Ker Range, Summit TV station (A), Cable Tower 3 (B and C); D, Bartle Frere, NW to Centre Peak. All to same scale.

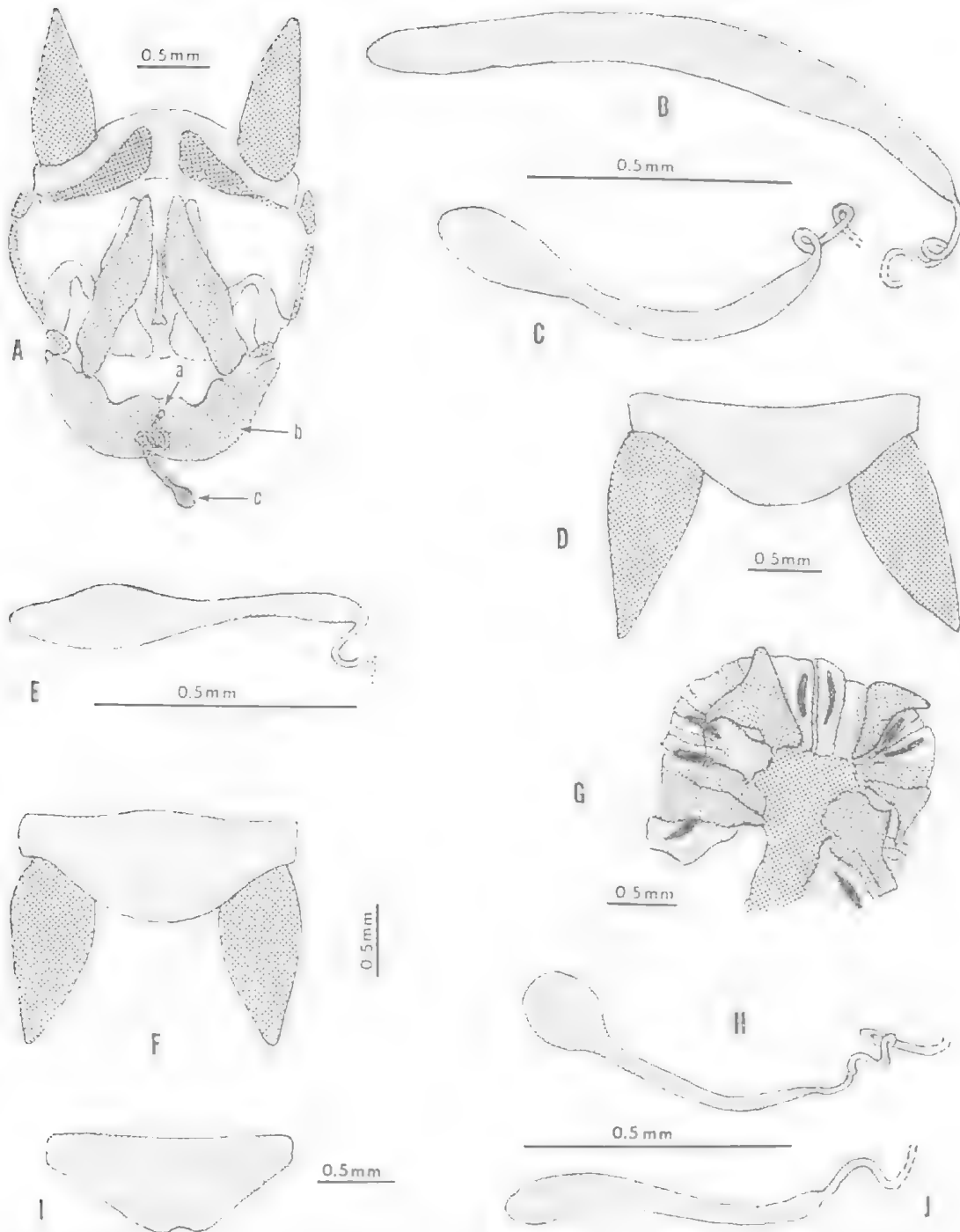


FIG. 6: *Tryonicus monteithi* n. sp., female paratypes from Queensland. A, Genitalia (a = spermathecal opening; b = basivalvula and spermathecal plate; c = spermatheca); B, C, Spermathecae. D, E, Supraanal plate and spermatheca, respectively; F-H, Supraanal plate, proventriculus (flattened), and spermatheca, respectively; I, J, Supraanal plate and spermatheca, respectively. Localities: A, Bellenden Ker Range, Summit TV station; B, Bartle Frere, NW Centre Peak; C, Mt. Bellenden Ker Centre Peak; D and E, Mt. Bellenden Ker Centre Peak summit; F-H, Mt. Edith, 2 miles north of Tinaroo Dam; I and J, The Bluff, 11 km west of Mossman.

metallic sheen. Abdominal tergites dark brown. Abdominal sternites and legs reddish brown, the former somewhat darker. Cerci dark brown (similar to abdominal tergites), or reddish brown (much lighter than tergites). Some specimens are dark reddish brown rather than blackish.

FEMALE. Tegmina lateral pads usually extending slightly beyond (Pl. 1, F), but sometimes level with hind margin of mesonotum. Hind margin of supraanal plate usually convexly rounded (Fig. 6A, D, F), sometimes with a weak concave indentation (Fig. 6I). Genitalia as in Fig. 6A. Spermatheca unbranched, terminal reservoir uniformly elongated (Fig. 6B, J), or with an elliptical or round distal swelling (Fig. 6C, E, H). Proventriculus as in Fig. 6G. Coloration dark brown or blackish brown.

MEASUREMENTS (mm) (· in parentheses). Body length, 11.0–13.7 (10.3–13.5); pronotum length \times width, 3.2–4.3 \times 4.0–5.5 (3.0–4.0 \times 3.9–4.9); tegmen length \times width, 3.1–4.5 \times 2.5–3.5 (1.0–2.0 \times 1.2–1.7).

REMARKS

Generally this is a larger and darker species than *mackerrasae*. Although the two taxa look quite different (size and color), many of the morphological characters are similar indicating a close relationship.

Of particular interest is the apparent polymorphism in the shape of the female spermatheca whose terminal reservoir varies from a straight tube more or less uniform in width, to one that has an elliptical or round distal swelling, the latter two forms occurring in *mackerrasae*. After preparing the first spermathecal slides I thought that the round terminal bulb in *mackerrasae*, and the straight tube in *monteithi* were good characters to differentiate the females of these taxa, especially in some specimens whose size was not clearly distinctive. However, additional preparations showed that the extent of spermathecal variation makes the use of this character doubtful; however, I have seen no *mackerrasae* spermathecae with a uniformly straight reservoir, unless I have misidentified some of the small females of *monteithi*. The taxonomic significance of spermathecal variation is unknown. Variability in the L2v of the male left genital phallomere also suggests that the species is in a fluid state.

Tryonicus sp. 1 (Fig. 7A–G)

MATERIAL EXAMINED

Queensland, QMBA: Mt. Demi, 7 km SW Mossman,

900–1000 m, 1♂ (slide 28), 26.v.1983, Monteith and Yeates; Mt. Lewis road, via Julatten, rain forest, 1♂ (slide 31), 12.x.1980, G.B. Monteith; Devil's Thumb area, 10 km NW Mossman, 1000–1180 m, 1♂ (slide 38), 9–10.x.1982, Monteith, Yeates, and Thompson, UQLA: Mt. Lewis, via Julatten, 3500 ft., 1♂ (slide 11), 4.v.1970, G.B. Monteith.

The above specimens look like miniature *monteithi* (particularly color), but I cannot place them unequivocally in that species.

DESCRIPTION

MALE. First abdominal tergite modified. Tegmina and wings as in *monteithi*. Hind margin of supraanal plate with a medial invagination (Fig. 7A) (usually rounded in *monteithi*). Subgenital plate as in Fig. 7B. L2v of left genital phallomere with a spine-like sclerotization; L2d with numerous small spines along the lateral posterior margin (Fig. 7C). Shining black (metallic), or dark brown; maxillary palps dark.

FEMALE. Tegmina as in *monteithi*. Hind margin of supraanal plate with a small shallow medial invagination (Fig. 7D, F). Spermatheca with terminal reservoir elongated, straight, without a bulbous swelling, inserted preapically, the small branch beyond the insertion about the same width as the common duct (Fig. 7E, G).

MEASUREMENTS (mm) (· in parentheses). Body length, 8.5–9.6 (8.5–10.3); pronotum length \times width, 3.0 \times 3.6–3.7 (2.6–3.1 \times 3.5–3.9); tegmen length \times width, 2.9–3.3 \times 2.3–2.6 (1.2–1.4 \times 0.9–1.2).

REMARKS

These specimens are somewhat small for *monteithi* and large for *mackerrasae*. Color is similar to *monteithi* (especially the dark palps and the metallic male). The male's left genital phallomere differs somewhat from those of the other 2 taxa, but this structure may be variable (at least in *monteithi*). The terminal portion of the female's spermatheca is elongated without a bulbous swelling, as in some *monteithi*, but it has a small branch beyond the point of insertion of the reservoir. *Tryonicus parvus* also has a branched spermatheca, but the large reservoir is round and bulbous, and the small branch is wider than the convoluted duct.

The male of *Tryonicus* sp. 1 keys out to couplet 5. In size and shape of hind margin of supraanal plate it is close to *mackerrasae*, but its coloration is similar to that of *monteithi*. The L2d and L2v of the male's left genital phallomere (Fig. 7C) differs somewhat from the two new species, but the L2v of *monteithi* may be variable (Fig. 5). The

size of the female is intermediate between *mackerrasae* and *monteithi* (couplets 10 and 11). Its spermatheca, unlike these two species, has a small branch beyond the insertion of the elongated distal reservoir (Fig. 7E, G), whose non-bulbous shape resembles that of some specimens of *monteithi* (Fig. 6B, J).

Whether these specimens are variants of *monteithi* and *mackerrasae*, or are a distinct taxon, requires a study of additional material. A male from Mt. Demi (same locality as the sp. 1 male from Mt. Demi) appears to be typical *mackerrasae*.

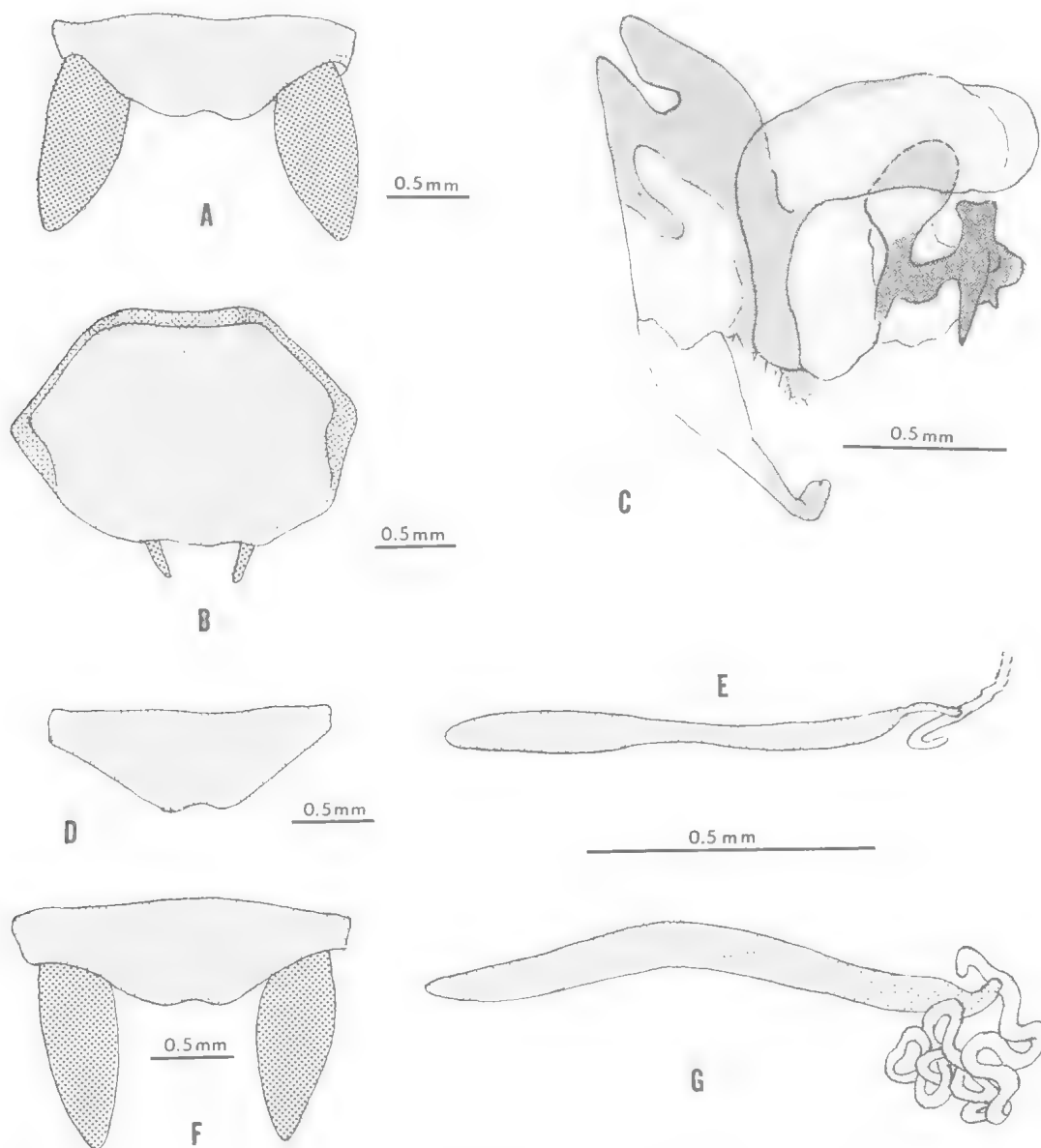


FIG. 7: *Tryonicus* sp. 1. A-C, Male (Mt. Lewis Road, via Julatten, Qld.): A, Supraanal plate; B, Subgenital plate; C, Left genital phallomere. D-G, Females: D and E, Supraanal plate and terminal portion of spermatheca (Mt. Lewis, Qld.); F and G, The same (Devils Thumb area, 10 km NW of Mossman, Qld.).

***Tryonicus angusta* (Chopard) n. comb.**
(Fig. 8A-H)

Stylopyga angusta Chopard, 1924, p. 332, figs 63, 64 (male and female).

Neostylopyga angusta (Chopard) Princis, 1966: 540.

MATERIAL EXAMINED

SYNTYPE: ♂, Forest of Mont Ignambi, New Caledonia, 8.vii.1911, Dr. S[arasin] and Dr. R[oux]; in the Basel Museum.

ADDITIONAL MATERIAL: New Caledonia, QMBA: All specimens were collected by G. Monteith and D. Cook: Table Unio, 700-1000 m, 2 ♀ (1 with slide 41), 10.v.1984; Mt. Rembai, 650 m, 1 ♂, 700-900 m, 2 ♀, 1 nymph, 9.v.1984; Mandjélia, above Pouébo, 600-750 m, 1 ♂, 11-13.v.1984; Mt. Do Summit, 1000 m, 1 ♂, 2 ♀ (1 with slide 42), 20.v.1984; Mt. Mou Summit, 1200 m, 1 ♀ (slide 43; spermatheca lost in preparation but similar to the one on slide 42), 20.v.1984.

DESCRIPTION

MALE. Dorsal surface of thorax with few, scattered, minute punctations. Pronotum strongly convex, with a shallow, median, longitudinal sulcus on posterior half. Tegmina and wings absent. First abdominal tergite unspecialized. Hind margin of T7 straight (Fig. 8A). Supraanal plate transverse, apex of hind margin rounded (Fig. 8A), shallowly concave (Fig. 8C, F), or truncate (Fig. 8E). Subgenital plate not extending beyond hind margin of supraanal plate, interstyler margin weakly convex (Fig. 8B). Front femur: anteroventral margin with 1 or 2 distal spines, posterior margin without spines; mid femur: anteroventral margin without spines or with 1 distal, posterior margin without spines; hind femur: anteroventral margin with 1 distal, posteroventral with 2 spines, none distal. Pulvilli

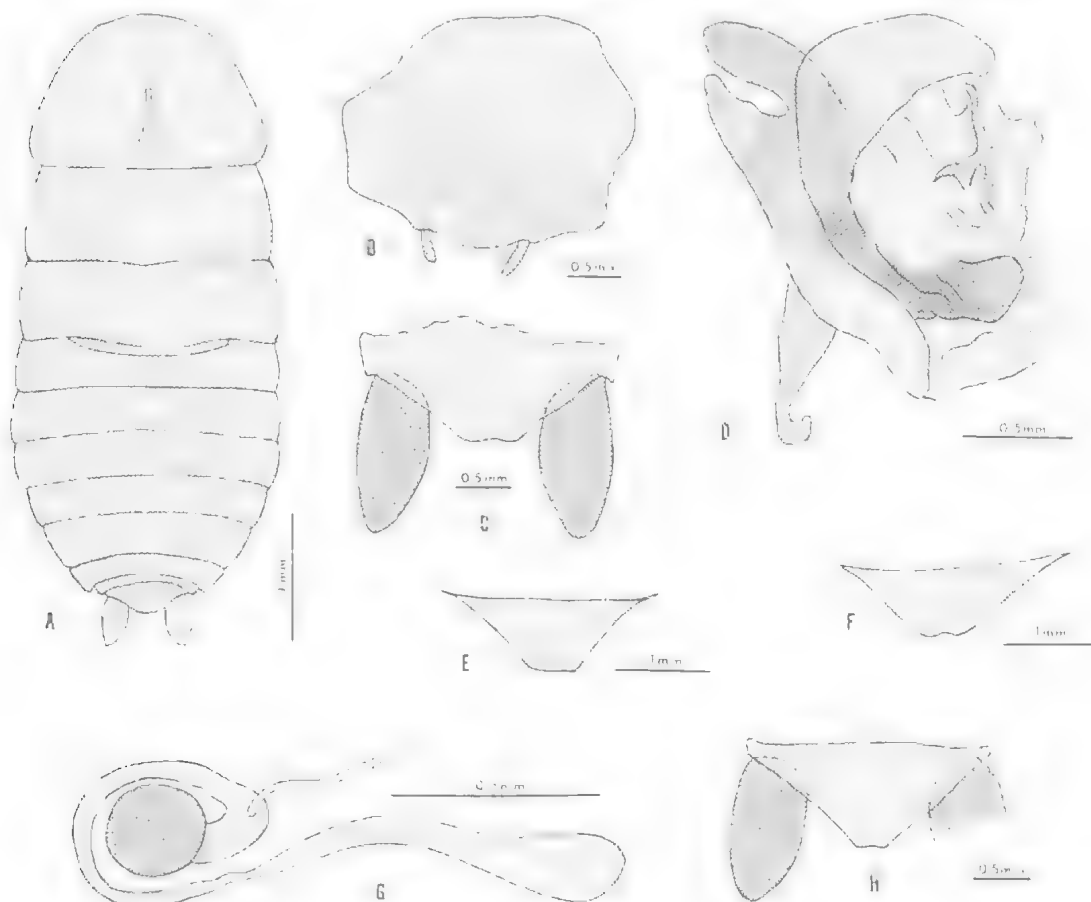


FIG. 8: *Tryonicus angusta* (Chopard) from New Caledonia. A, Male from Table Unio, habitus. B-F, Males: B-D, from Table Unio, subgenital plate, supraanal plate, and left genital phallomere, respectively; E, F, Supraanal plates from Mandjélia, and Mt. Do, respectively. G, H, Female from Mt. Do, spermatheca and supraanal plate respectively.

appear to be absent from most of the tarsal segments, but in some specimens they are recognizable on the fourth segment, and sometimes the third as well. Left genital phallomere as in Fig. 8D.

Coloration. Black or reddish brown, usually shiny. Head black, clypeus yellow. Antennae and legs reddish brown, palps brown.

FEMALE. Habitus similar to male. Supraanal plate transverse, trigonal, hind margin with (Fig. 8H) or without a shallow medial indentation. Legs similar to males with following differences in femoral armament: mid femur: posteroventral margin without or with 1 spine; hind femur: posteroventral margin with 0–2 spines. Spermatheca with a slender duct leading into a sclerotized enlarged reservoir which is very dark

and spherical at one end and somewhat lighter and club-shaped on the other (Fig. 8G).

MEASUREMENTS (mm) (\pm in parentheses). Body length, 10.6–13.5 (11.0–14.2); pronotum length \times width, 3.4–4.0 \times 4.1–4.8 (3.5–4.0 \times 4.3–4.8).

NYMPH. A male nymph (11.5 mm) resembles the adult but its supraanal plate is more strongly trigonal with the lateral margins somewhat undulate. Body color dark brown, legs yellowish brown.

REMARKS

This is the only species of *Tryonicus* in which the males lack tegmina. *T. angusta* is close to *parvus* (absence of male tergal gland, and similarities in left male genital phallomere). The spermathecae of the two species are strikingly different.

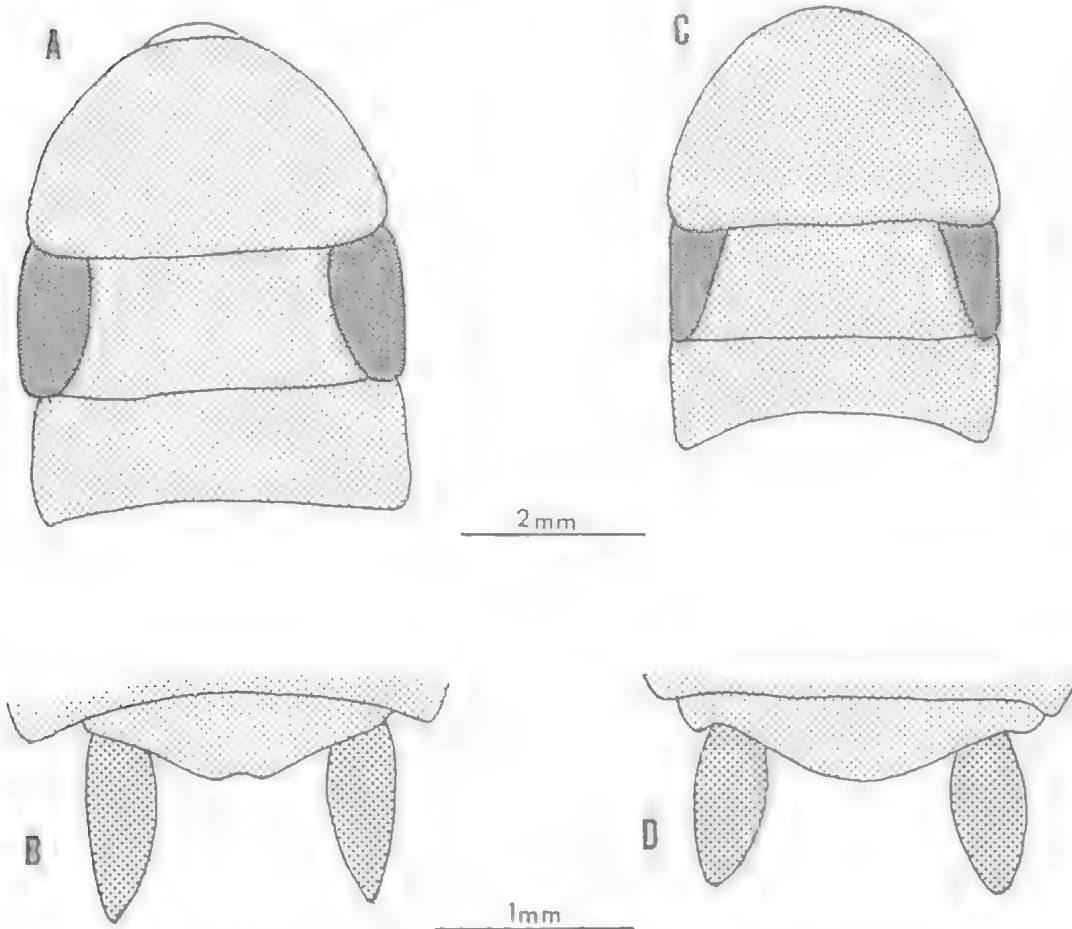


FIG. 9: A, B, *Tryonicus rufescens* (Chopard), female syntype, thorax and regmina, and supraanal plate, respectively. C, D, *Tryonicus vicina* (Chopard), female holotype, thorax and tegmina, and supraanal plate, respectively.

***Tryonicus rufescens* (Chopard) n. comb.**
(Fig. 9A, B)

Stylopyga rufescens Chopard, 1924, p. 333, figs 65–67 (male and female).

Neostylopyga rufescens (Chopard), Princis, 1966, p. 540.

MATERIAL EXAMINED

SYNTYPE: ♀, Ignambi, New Caledonia, vii.1911, Drs. S[arasin] R[oux]; in the Basel Museum.

DESCRIPTION

FEMALE. Tegmina with anterior border straight, posterior border convex, apex subtruncate, reaching to hind margin of mesonotum; hind margin of metanotum practically straight (Fig. 9A). Supraanal plate transverse, trigonal, apex weakly indented (Fig. 9B). The only female I have seen has the front and mid legs missing, and damaged hind legs. The anterior and posterior ventral margins of the hind femurs have 4 or 5 large spines and 1 terminal spine; the left leg has only 4 non-pubescent tarsi and the metatarsus has 2 rows of spines along the entire ventral margin.

Coloration. Reddish brown. Head dark brown, antennae, clypeus, and palps yellowish. Legs reddish.

MEASUREMENTS (mm). Length, 9.3; pronotum length \times width, 2.6×4.0 ; tegmen length \times width, 1.7×0.8 .

MALE. I have not seen the male of this species. From Chopard's description, the tegmina apparently are similar to those of the female (i.e. squamiform). The supraanal plate is triangular, with hind margin subtruncate. Subgenital plate with posterior margin convex, styles rather long, close together, subacute.

***Tryonicus vicina* (Chopard) n. comb.**
(Fig. 9C, D).

Stylopyga vicina Chopard, 1924, p. 334, figs 68, 69 (male and female).

Neostylopyga vicina (Chopard), Princis, 1966, p. 540.

MATERIAL EXAMINED

HOLOTYPE: ♀, Summit of Mont Humboldt, New Caledonia, 1600 m, 18.viii.1911 (not Nov., as indicated); in the Basel Museum.

DESCRIPTION

FEMALE. Antennae pubescent. Tegmina very narrow, inner margin straight, tapering to a subacute apex, reaching to hind margin of mesonotum; wings absent; hind margin of metanotum concave (Fig. 9C). Supraanal plate transverse, hind margin broadly rounded, not indented medially (Fig. 9D). Pulvilli and arolia

absent; tarsi pubescent. Front femur: anteroventral margin with 2 large proximal spines followed by a row of piliform setae, plus 2 terminal or distal spines; posteroventral margin with 1 distal spine. Mid femur: anteroventral margin with 2 spines on distal half, plus 1 terminal spine, posterior margin with 3 spines on distal half plus 1 terminal. Hind femur: anteroventral margin with 3 distal and no terminal spines; posterior margin with 2 distal and 1 terminal spine.

Coloration. Reddish brown. Head similar to pronotal disk. Pronotum with anterior and most of lateral borders lighter than the disk region. Antennae, palps and legs light brown.

MEASUREMENTS (mm). Length, 9.0; pronotum length \times width, 2.5×3.6 ; tegmen length \times width, 1.6×0.7 .

REMARKS

According to Chopard, the male (which I have not seen) has tegmina and the concave hind margin of the metanotum, similar to the female.

ACKNOWLEDGEMENTS

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THREE NEW *POLYRHACHIS SEXSPINOSA*-GROUP SPECIES FROM THE PHILIPPINES (HYMENOPTERA : FORMICIDAE)

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ABSTRACT

Eight species of the *Polyrhachis sexspinosa* species-group are recorded from the Philippines. Three (*P. exotica*, *P. ignota* and *P. scabra*) are described as new and two (*P. aureovestita* Donisthorpe and *P. calypso* Forel), previously described from elsewhere, are recorded from the Philippine Islands for the first time. A key to all species of the group known to occur in the Philippines is provided.

INTRODUCTION

The *Polyrhachis sexspinosa* species-group was revised recently by Bolton (1975). He recognised twelve species, two of which, *P. magnifica* Menozzi and *P. osiris* Bolton, are apparently endemic to the Philippines, and gave full reference citations, which are not repeated here. My studies on the systematics of Indo-Australian *Polyrhachis* have resulted in the recognition of three new species from Mindanao. They are described here as *P. exotica* n.sp., *P. scabra* n.sp. and *P. ignota* n.sp. The first two were originally received from a private collection, without data, but certainly originating from somewhere in the Philippines probably Mindanao. Their presence there was later confirmed by specimens received from the Bernice P. Bishop Museum, Hawaii, through the kindness of Dr Gordon Nishida. The occurrences of *P. aureovestita* Donisthorpe, *P. calypso* Forel and *P. sexspinosa* (Latr.) were also verified from this material, and the third new species (*P. ignota*) was discovered. This brings to eight the number of *P. sexspinosa*-group species found in the Philippines.

The illustrations were drawn using a Zeiss (Oberkochen) SR Stereomicroscope and camera lucida. Those of the new species and of *P. osiris* depict holotypes.

The conventions of measurements and indices used in this paper are identical to those of Bolton (1973, 1975).

The following abbreviations are used for institutions and depositories: ANIC = Australian National Insect Collection, CSIRO, Canberra; BMNH = British Museum (Natural History), London; BPBM = Bernice P. Bishop Museum, Honolulu; USNM = National Museum of Natural History, Smithsonian Institution, Washington, D.C.; QM = Queensland Museum, Brisbane; RJK = R.J. Kohout, Brisbane (private collection).

KEY TO *P. SEXSPINOSA*-GROUP SPECIES RECORDED FROM PHILIPPINES (BASED ON WORKER CASTE)

1. First gastral tergite covered with fine, rather dense pubescence, which is arranged in a characteristic midline pattern (Fig. 12) 2
First gastral tergite smooth and shining; pubescence almost completely absent from dorsal surface of the gaster (Fig. 9).....
..... *P. exotica*, sp. nov.
2. Petiolar spines relatively long, elevated, recurved and hook-like (Figs 18, 19)
..... *P. calypso* Forel
Petiolar spines relatively short, scarcely elevated, not developed into recurved hooks.
..... 3
3. Head strongly contracted behind eyes, the occipital margin narrow, neck-like; antennal scapes relatively long (SI > 190)..... 4
Head not strongly contracted behind eyes, the occipital margin broad; antennal scapes relatively short (SI < 190), (Fig. 16).....
..... *P. aureovestita* Donist.
4. Antennal scapes with numerous short erect hairs (Figs 5, 17) 5
Antennal scapes without erect hairs, or with only a few inconspicuous solitary short hair present (Figs 6, 13, 14)..... 6
5. Occipital margin with lateral angular prominences, which are visible in full face view (Fig. 17) *P. sexspinosa* (Latr.)
Occipital margin without lateral angular prominences, short and collar-like (Fig. 5) ...
..... *P. osiris* Bolton
6. Extensor surfaces of middle and hind tibiae with moderately long erect hairs 7

- Extensor surfaces of middle and hind tibiae without erect hairs *P. magnifica* Menozzi
7. Pronotal dorsum strongly convex in profile (Fig. 7)..... *P. ignota*, sp. nov.
- Pronotal dorsum only moderately convex in profile (Fig. 8)..... *P. scabra*, sp. nov.

***Polyrhachis aureovestita* Donisthorpe, 1937**
(Fig. 16)

MATERIAL EXAMINED

MINDANAO: Zamboanga del Sur, Lemesahan, 600 m, 7.ix.1958, light trap, H.E. Milliron, BPBM coll. (1 worker); Agusan, S. Francisco, 10 km SE, 13.xi.1959, L. Quate & C. Yoshimoto, BPBM coll. (1 alate female).

DIMENSIONS

Worker cited first: TL 14.76, 16.07; HL 3.53, 3.63; HW 2.32, 2.42; CI 66, 67; SL 4.38, 4.33; SI 189, 179; PW 2.02, 2.37; MTL 5.34, 5.34.

REMARKS

Both specimens closely match the holotype of *P. aureovestita*. They represent the first records of this species from the Philippines.

***Polyrhachis calypso* Forel, 1911**
(Figs 18, 19)

MATERIAL EXAMINED

SULU: Tawitawi, Tarakan, Farm. distr., 11.ii.1957, Yoshio Kondo, BPBM coll. (1 worker).

DIMENSIONS

TL 10.28; HL 2.40; HW 1.50; CI 62; SL 3.03; SI 202; PW 1.25; MTL 3.58.

REMARKS

Not previously recorded from the Philippines. In spite of some minor differences, including the slightly narrower head and the reduced pilosity, the single worker closely matches the syntypes and other available material of *P. calypso* from Borneo, Sumatra and Java.

***Polyrhachis exotica*, sp. nov.**
(Figs 9, 11, 15)

MATERIAL EXAMINED

MINDANAO: Misamis Oriental, Mt. Kibungol, 10.-11. April 1960, H.M. Torre Villas, BPBM coll. (Holotype, 2 paratype workers); Mt. Kibungol, 20 km SE of Gingoog, 700-800 m, 9.-18.iv.1960, H.M. Torre Villas, BPBM coll. (3 paratype workers); Mt. Empagatao, 9.-18. April 1961, H.M. Torre Villas, BPBM coll. (1 paratype worker, 2 paratype dealate females); Hindangon, 20 km S of Gingoog, 600-700 m, 20.-24.iv.1960, H. Torre Villas, BPBM coll. (2 paratype workers); Minalwang, 1050 m,

24.iii.-4.iv.1961, W. Torre Villas, BPBM coll. (1 paratype worker); MINDANAO, no further data, ex C. Danes coll. (3 paratype workers, 1 paratype dealate female).

TYPE DEPOSITION: Holotype and most paratypes (6 workers and 2 females) in BPBM; 3 paratypes (2 workers, 1 female) in RJK; 1 paratype worker each in ANIC, BMNH, USNM and QM (with kind consent of Bernice P. Bishop Museum).

DESCRIPTION

WORKER

Dimensions (holotype cited first): TL 14.46, 13.31-14.66; HL 3.43, 3.17-3.43; HW 2.22; 2.07-2.22; CI 65, 64-66; SL 4.48, 4.28-4.59; SI 202, 201-207, PW 2.06, 1.96-2.17; MTL 6.05, 5.74-6.10 (13 measured).

Mandibles with 4 distinct teeth. Clypeus with a median longitudinal carina; convex in profile. Sides of head in front of eyes feebly convex, nearly straight; narrowed behind eyes with occipital margin narrow and without lateral angular prominences. Antennal carinae well elevated, sinuate; the furrow between them 2 x as wide in front than behind. Antennal scapes long, extending beyond the occipital margin by at least half their length. Eyes convex, but not as prominent as in some species of the group. Median ocellus present, though rather obscure in some specimens. Pronotum in profile very strongly convex, dome-like. Pronotal spines long, projecting laterally and strongly curved forward. Mesonotal dorsum in profile straight; propodeal dorsum shallowly concave, declivity abrupt. Mesopleural process produced to form an acute ventral angle. Propodeal spines very strong, long, elevated from their bases, divergent and recurved. Petiole with dorsum sloping anteriorly, spines scarcely elevated and curved to the base of gaster, which is short and broadly ovate; first tergite covering almost half of the gastral dorsum.

Mandibles relatively smooth and shining at the masticatory border; punctate-opaque laterally, with numerous piliferous pits at their bases. Sculpturation a fine reticulate punctation on clypeus, front and sides of head; increasing posteriorly to coarsely punctate on vertex and at the occipital border. Mesosoma and petiole fairly coarsely and closely punctate; sides of mesonotum and propodeum foveolate-punctate. Dorsum of gaster shining, with only very fine microscopic punctations.

All surfaces of the body and appendages, except the tips of spines and dorsum of the first gastral segment, with numerous yellow or off-white long erect undulate hairs. These are longest and most dense on the mesosomal dorsum and

only slightly shorter on the head, petiole, gaster and legs. Appressed, somewhat radiating, bright golden pubescence abundant all over the body, except the mandibles, legs, apices of pronotal, propodeal and petiolar spines, and most of gaster (where it is much diluted, and virtually absent from dorsal aspect of the first tergite).

Head and body black or very dark reddish brown; mandibles at the masticatory border, apical portions of antennal segments, subpetiolar process and legs reddish brown, the femora always a shade lighter. Gaster black with deep red reflections.

FEMALE

Dimensions: TL 16.08–16.63; HL 3.73–3.88; HW 2.47–2.57; CI 65–67; SL 4.74–4.99; SI 190–196; PW 2.37–2.47; MTL 6.20–6.35 (3 measured).

Females differ from workers in the usual characters identifying full sexuality — three ocelli, complete mesosomal structure and wings. The sculpturation, pilosity and colour patterning is identical, but development of the spines is different. The pronotal spines are short and stout, projecting laterally and bent only weakly forward. The propodeal spines are directed posteriorly, projecting horizontally, with their tips curved slightly inwards. The petiolar spines are closely similar to those of the workers, but slightly shorter.

MALE AND IMMATURE STAGES

Unknown.

REMARKS

This species is a very distinct member of the *P. sexspinosa*-group. It possesses all the combined characters of the group except that the gaster is smooth and shining, in contrast to those of other species, where it is characteristically pubescent. This character together with the exceptionally produced pronotal dorsum render *exotica* immediately identifiable, and readily separable from any other member of the *sexspinosa*-group.

Polyrhachis ignota sp. nov. (Figs 7, 10, 13)

MATERIAL EXAMINED

MINDANAO: Zamboanga del Sur, Lemesahan, 600 m, 7.–8.ix.1958, H.E. Milliron, BPBM coll. (Holotype, 2 paratype workers).

TYPE DEPOSITION: Holotype and 1 paratype in BPBM; 1 paratype in RJK.

DESCRIPTION

WORKER

Dimensions (holotype cited first): TL 14.36, 13.26–14.97; HL 3.48, 3.17–3.43; HW 2.07, 1.86–2.07; CI 59, 59–60; SL 4.54, 4.43–4.48; SI 219, 216–238; PW 1.81, 1.66–1.81; MTL 6.20, 5.90–6.20 (3 measured).

Mandibles with 5 teeth. Clypeus carinate, sinuate in profile (convex above and concave below). Sides of head in front of eyes only feebly convex, almost straight; strongly narrowed behind eyes. Occipital margin narrow, collar-like, without lateral angular prominences. Antennal carinae elevated, sinuate. Antennal scapes extending beyond occipital border by nearly half their length. Eyes convex. Pronotum strongly convex, distinctly swollen (though not to such a degree as in *P. exotica*); pronotal spines stout, projecting laterally, only slightly curved forward. Mesonotal dorsum in profile feebly convex, propodeum shallowly concave, declivity abrupt. Metanotal groove replaced by a minutely raised ridge. Mesopleural process represented as a non-acute simple lobe. Propodeal spines elevated at their bases, divergent and recurved. Petiole relatively low in front; its dorsum shallowly concave in profile, sloping anteriorly, and with a weak median longitudinal ridge similar to that in *P. osiris*. Apices of petiolar spines scarcely elevated, the spines short. Gaster, when contracted, short, broadly ovate.

Mandibles smooth and shining at the masticatory border, densely punctate at their bases, intervening surfaces with graded sculpturation. Clypeus and front of head finely reticulate-punctate; sculpturation increasing posteriorly in intensity and density, so that the dorsal face and lateral branches of occiput are somewhat coarsely rugose. Mesosomal dorsum with weak rugosity, decreasing posteriorly in intensity and density. Gaster very finely reticulate-punctate.

White or yellowish erect hairs present in variable density all over the body and appendages, but absent from the antennal scapes. Relatively long, suberect, somewhat radiating rich golden pubescence variously developed; most dense on head and mesosomal dorsum, rather diluted on lateral portions of mesosoma (the specimens might be somewhat worn). Gastral pubescence ranging from yellow on anterodorsal aspect of first tergite to silvery white elsewhere, arranged in a characteristic midline pattern.

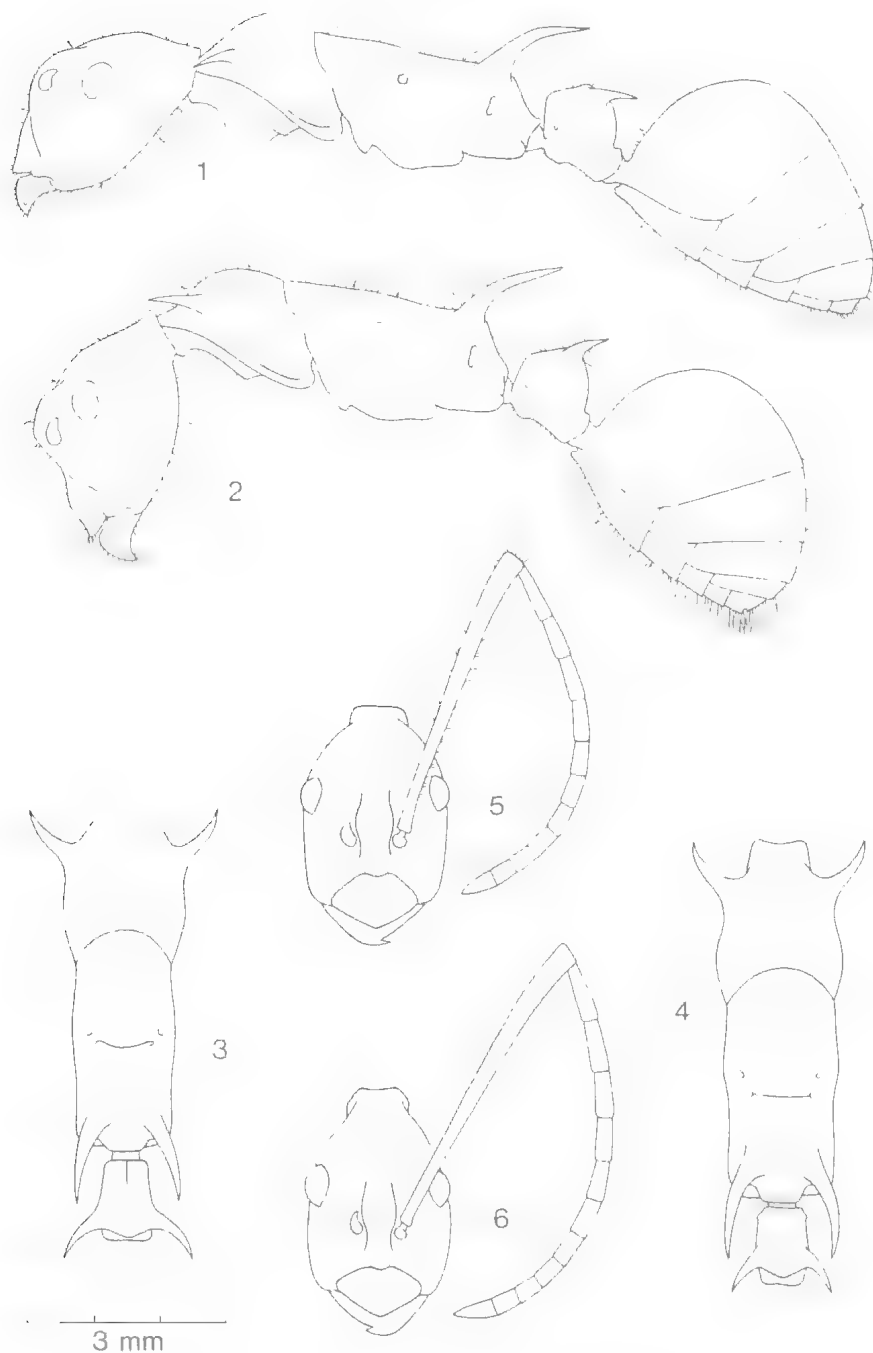
Body and appendages black.

SEXUALS AND IMMATURE STAGES

Unknown.

REMARKS

This is the third *P. sexspinosa*-group species from Philippines which lacks hairs on the antennal



FIGS 1-2: Lateral view (antennae and legs omitted); 1 — *P. osiris*; 2 — *magnifica*.

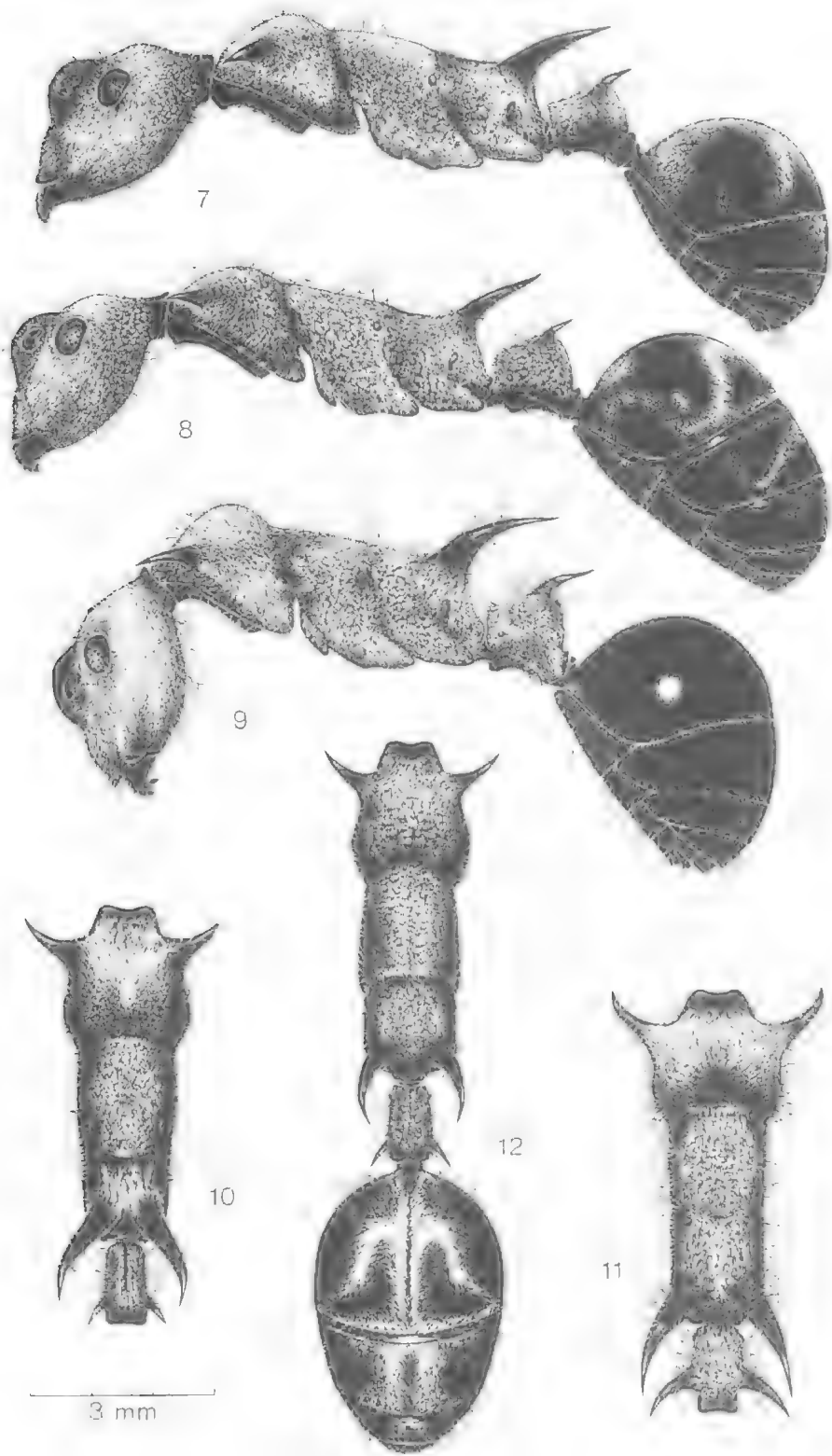
FIGS 3-4: Dorsal view of mesosoma and petiole (pilosity omitted); 3 — *P. osiris*; 4 — *magnifica*.

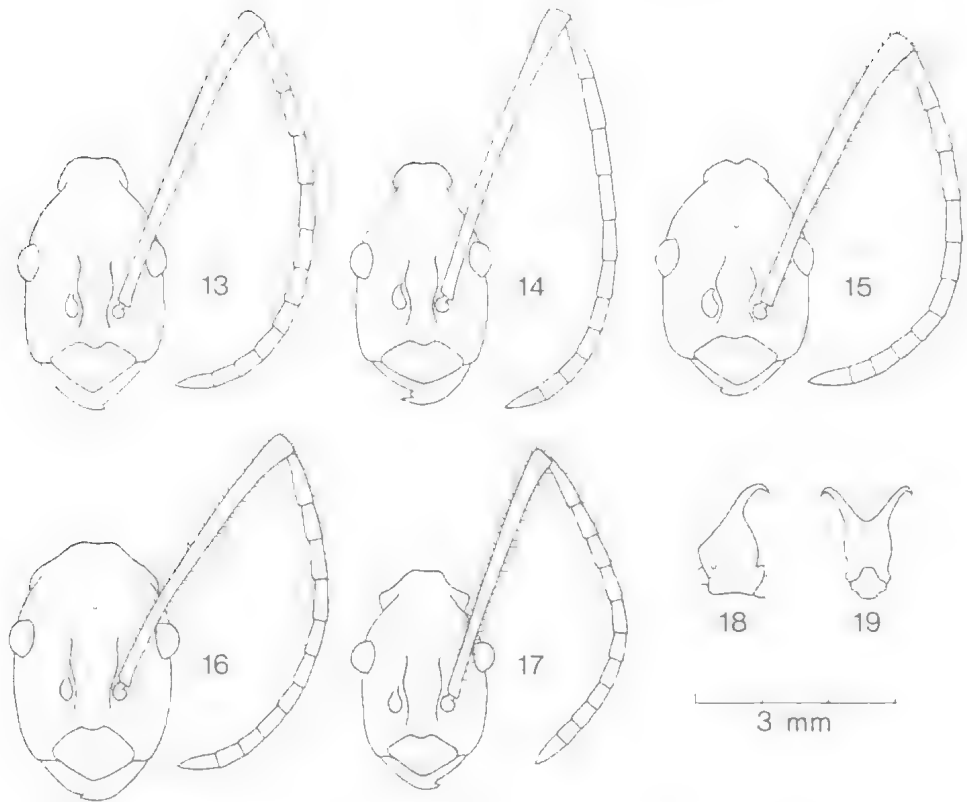
FIGS 5-6: Head in full face view (right antennae and cephalic pilosity omitted); 5 — *P. osiris*; 6 — *magnifica*.

FIGS 7-9: Lateral view (antennae and legs omitted); 7 — *P. ignota*; 8 — *scabra*; 9 — *exotica*.

FIGS 10-11: Dorsal view of mesosoma and petiole; 10 — *P. ignota* (tip of the right spine on holotype broken off); 11 — *exotica*.

FIG. 12: Dorsal view of mesosoma, petiole and gaster of *P. scabra*.





FIGS 13-17: Head in full face view (right antenna and cephalic pilosity omitted); 13 — *P. ignota*; 14 — *scabra*; 15 — *exotica*; 16 — *aureovestita*; 17 — *sexspinosa*.

FIGS 18-19: Petiole of *P. calypso*; 18 — lateral; 19 — anterior.

scapes (the others are *P. magnifica* and *P. scabra*). *P. ignota* differs from *magnifica* in having erect hairs present on the extensor surfaces of the middle and hind tibiae and in the structure of the pronotal spines. In *P. ignota* these are quite short, and only weakly curved, while in *P. magnifica* they are long and strongly curved forward. *P. ignota* differs from *P. scabra* in having a strongly produced pronotal dorsum, which is only moderately convex in *scabra*.

***Polyrhachis magnifica* Menozzi, 1925**
(Figs 2, 4, 6)

MATERIAL EXAMINED

NEGROS: Talay, Valencia, 8.i.1961, H.M. Torrevillas;
LUZON: Camarines Sur, Mt. Iriga, 500-600 m, 4.-17.May 1962, H.M. Torrevillas; Camarines Sur, Mt. Isarog, 750-850 m, 20 km E of Naga, 4.-11.April 1963,

H.M. Torrevillas (all BPBM coll.); LUZON, no further data, ex C. Danes coll.

REMARKS

This species was adequately described by Menozzi, and redescribed by Bolton (1975). The pubescence of specimens from Mt. Isarog tends to be more silvery than in the other populations where it is consistently brightly golden.

***Polyrhachis osiris* Bolton, 1975**
(Figs 1, 3, 5)

REMARKS

I have been able to examine the holotype through the kindness of Barry Bolton. Apart from *P. exotica*, this is the only endemic Philippine species of the group with erect hairs on the antennal scapes.

***Polyrhachis scabra*, sp. nov.**

(Figs 8, 12, 14)

MATERIAL EXAMINED

MINDANAO: Agusan, 10 km SE S. Francisco, 12.Nov.1959, Quate & Yoshimoto, BPBM coll. (Holotype, 2 paratype workers); Misamis Oriental, Mt. Empagatao, 9.-18.April 1961, H.M. Torrevillas, BPBM coll. (3 paratype workers); Agusan, Esperanza, 4.-11.xi.1959, C.M. Yoshimoto, BPBM coll. (1 paratype worker); Zamboanga del Sur, 11 km NW of Milbuk, 390 m, 5.viii.1958, H.E. Milliron, BPBM coll. (1 paratype worker); Surigao, L. Mainit, 23.xi.-1.xii.1959, C.H. Yoshimoto, BPBM coll. (1 paratype worker); Misamis Or., Balason, 1.iv.1960, H. Torrevillas, BPBM coll. (1 pseudogyne); MINDANAO, no further data, ex C. Danes coll. (2 paratype workers, 1 paratype dealate female).

TYPE DEPOSITION: Holotype and 5 paratypes (4 workers and 1 pseudogyne) in BPBM; 3 paratypes (2 workers, 1 dealate female) in RJK, 1 paratype worker each in ANIC, BMNH, USNM and QM (with kind consent of Bernice P. Bishop Museum).

DESCRIPTION**WORKER**

Dimensions (holotype cited first, pseudogyne last): TL 14.81, 13.56-15.06, 16.48; HL 3.43, 3.22-3.58, 3.93; HW 2.02, 1.86-2.12, 2.37; CI 59, 58-61, 60; SL 4.74, 4.38-4.89, 5.14; SI 235, 227-237, 217; PW 1.66, 1.56-1.81, 2.02, MTL 6.25, 5.85-6.35, 6.80 (12 measured).

Mandibles with five teeth. Clypeus carinate, sinuate in profile (convex above, concave below). Sides of head in front of eyes almost straight, strongly contracted behind eyes, with narrow occipital margin, lacking lateral angular prominences. Antennal carinae rising sharply, sinuate. Antennal scapes long, extending beyond the occipital margin by about half their length. Eyes convex. Pronotum in profile moderately convex; pronotal spines long, slender, projecting laterally and curved forward. Mesonotal dorsum straight in profile, propodeal dorsum shallowly concave, declivity abrupt. Metanotal groove replaced by a minute ridge. Mesopleural process represented as a dentiform lobe with acute ventral angle. Propodeal spines long, elevated at their bases, diverging and recurved. Petiole with dorsum sloping anteriorly; spines scarcely elevated, short.

Mandibles punctate-opaque with numerous piliferous pits. Sculpturation consists of very fine punctation on clypeus, front and sides of head, increasing posteriorly to densely, but shallowly punctate. Dorsum of mesosoma densely, but shallowly punctate, sculptural intensity increasing laterally to coarsely punctate. Gaster very finely reticulate-punctate.

All body surfaces except antennal scapes with rather diluted, moderately long, undulate, silvery white hairs. These are longest on mesosomal dorsum and shortest on lateral portions of mesosoma, and on the gastral dorsum. Silvery white, somewhat radiating, appressed pubescence abundant over entire body, including gastral dorsum, where it forms the midline pattern characteristic of most members of the group.

Body black with the appendages dark reddish brown.

The single *pseudogyne* (in the terminology of Wheeler, 1910) represents a worker-like form with transversely enlarged mesonotum, which is convex in profile. The sculpturation and pilosity are essentially as in the worker.

FEMALE

Dimensions: TL 15.51; HL 3.63; HW 2.17; CI 60; SL 4.69; SI 216; PW 2.02; MTL 5.80 (1 measured).

The female differs from the worker in the usual sexual characters, including the reduction in length of pronotal and propodeal spines. The sculpturation and pilosity similar to that in worker.

MALE AND IMMATURE STAGES

Unknown.

REMARKS

This species stands close to *P. magnifica* and bears a superficial resemblance to the silvery pubescent population of that species from Mt. Isarog, Luzon Island. The main distinguishing features additional to that given in the key, are the longer antennal scapes of *scabra*, along with its more dense sculpturation and a more gracile build.

***Polyrhachis sexspinosa* (Latreille), 1802**

(Fig. 17)

MATERIAL EXAMINED

MINDANAO: Zamboanga del Sur, Lemesahan, 600 m, 7.ix.1958, light trap, H.E. Milliron, BPBM coll. (3 workers in poor condition).

DIMENSIONS

TL 12.41-13.00; HL 2.97-3.17; HW 1.86-1.94; CI 61-63; SL 3.78-3.93; SI 203-206; PW 1.56-1.76; MTL 4.74-4.99 (3 measured).

REMARKS

Recorded previously from the Philippines by various authors (Smith 1858, 1859, 1863; Mayr 1867; Viehmeyer 1916; Stitz 1923; Emery 1925; Domsthorpe 1943; Baltazar 1966). The three specimens before me differ from those of typical

New Guinean populations of *P. sexspinosa* (as defined by Bolton, 1975) in having the sculpturation of the head and body more reduced and almost completely masked by a rich yellowish pubescence. In spite of these differences, and in view of the general similarity between these specimens, and the absence of additional material, I feel obliged to consider them as representatives of *P. sexspinosa* (Latreille).

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STUDY OF A LOWER CRETACEOUS ACTINOPTERYGIAN (CLASS PISCES)
COOYOO AUSTRALIS FROM QUEENSLAND, AUSTRALIA

TEMPE LEES
and
ALAN BARTHOLOMAI
Queensland Museum

ABSTRACT

The Lower Cretaceous actinopterygian fish *Xiphactinus australis* Woodward, 1894 is redescribed from new material. Comparisons of this taxon with other ichthyodectid genera, *Xiphactinus*, *Ichthyodectes*, *Cladocycclus* and *Gillicus*, shows it is sufficiently distinct to warrant recognition in a separate genus, *Cooyoo* gen. nov.. In addition *C. australis* is shown to be more closely related to *Ichthyodectes* than *Xiphactinus*.

INTRODUCTION

Woodward (1894) described an isolated partial teleost skull from Lower Cretaceous marine sediments of Queensland and identified it as the new species, *Portheus australis*. *Portheus* was later shown by Hay (1897) to be a junior synonym of *Xiphactinus*, a conclusion followed by most subsequent workers.

Since Woodward's (1894) description, no further work has been carried out on this species. During this time, the Queensland Museum has acquired a number of excellent specimens of this fish, including an almost complete skeleton, several well preserved skulls and a neurocranium, as well as numerous pieces of vertebrae, partial crania, jaws and skeletal fragments. The material, collected from marine sediments of the Hughenden, Richmond and Boulia areas of Central Queensland, forms the basis for the current revision and allows for a more complete description and identification of the species.

Detailed comparison is made with four ichthyodectid genera: *Xiphactinus* Leidy, 1870, *Ichthyodectes* Cope, 1870, *Cladocycclus* Agassiz, 1841 and *Gillicus* Hay, 1898. This indicates that the Queensland species requires separate generic status.

Relationships with the Ichthyodectidae have

been discussed by several workers, namely Bardack (1965), Bardack and Sprinkle (1969), Cavender (1966), Nelson (1973), Taverne (1973, 1974) and, most recently, Patterson and Rosen (1977). The classification of Ichthyodectiformes proposed by Patterson and Rosen (1977) will be followed:

O. ICHTHYODECTIFORMES Bardack and Sprinkle, 1969

S.O. ALLOTHRISOPOIDEI Patterson and Rosen, 1977

F. Allothrissopidae Patterson and Rosen, 1977
Genus *Allothrissops* Nybelin, 1964

S.O. ICHTHYODECTOIDEI Romer, 1966

F. Ichthyodectidae Crook, 1892

Ichthyodectes Cope, 1870, *Xiphactinus* Leidy, 1870, *Gillicus* Hay, 1898, *Cladocycclus* Agassiz, 1841, *Eubiodectes* Hay, 1903, *Proportheus* Jaekel, 1909, *Chriocentrites* Hackel, 1849, *Thrissops* Agassiz, 1833, *Spathodactylus* Pictet, 1858, *Cooyoo* gen. nov.

F. Saurodontidae Cope, 1871

Saurodon Hays, 1930, *Saurocephalus* Harlan 1824

SPECIMEN DESIGNATIONS

QMF — Queensland Museum specimen, GSQ
— Geological Survey of Queensland specimen.

ABBREVIATIONS IN FIGURES

Terminology follows Bardack (1965)

Ang.	angular
Boc.	basioccipital
bpt. pr.	basipterygoid process
Bsc.	basisclerotic
Bsp.	basisphenoid
Dent.	dentary
Ect.	ectopterygoid
eff. ps. a.	foramen for efferent pseudobranchial artery
Epo.	epiotic
Eth.	ethmoid
Exo.	exoccipital
f.m.	foramen magnum
Fr.	frontals
Hym.	hyomandibular
hym. f.	hyomandibular fossa
inf. f.	infundibular fossa
Int.	intercalar
lat. head v.	lateral head vein
lat. temp. f.	lateral temporal fossa
Max.	maxillary
Mes.	mesopterygoid
Mpt.	metapterygoid
Op.	operculum
Pal.	palatine
Par.	parietal
Pas.	parasphenoid
Pmx.	premaxillary
Pop.	preoperculum
Pro.	prootic
pro. br.	prootic bridge
ptm. f.	post-temporal fossa
Pto.	pteric
Qu.	quadrate
Ra.	retroarticular
Sclr.	sclerotic
se. f.	Subepiotic fossa
Soc.	supraoccipital
Sph.	sphenotic
IX	foramen for glossopharyngeal nerve
X	foramen for vagus nerve

Superorder TELEOSTEI

Order ICHTHYODECTIFORMES Bardack and Sprinkle, 1969

Suborder ICHTHYODECTOIDEI Romer, 1966
Family ICHTHYODECTIDAE Crook, 1892Genus *Cooyoo* gen. nov.

DIAGNOSIS

Medium-sized ichthyodectid teleost (single complete individual 1.1 m). Supraoccipital crest rises above the dorsal surface of the neurocranium at a mean angle of 15°, significantly lower than in both *Xiphactinus* (30°) and *Ichthyodectes* (39°). Fused parietals unornamented. Frontals possess raised, medially concave ridges originating at anterior base of parietal hump, diverging to form part of dorsolateral margin of brain case; anteriorly, the ridges converge to complete an oval-shaped ring bounding anterodorsal surface of neurocranium; between the ridges, frontals are smooth and rise to a peak at midline; frontals also exhibit laterally directed, triangular-shaped shelf. No ridges have been observed on the frontals of *Xiphactinus*; in *Ichthyodectes* ridges are present, but are medially convex.

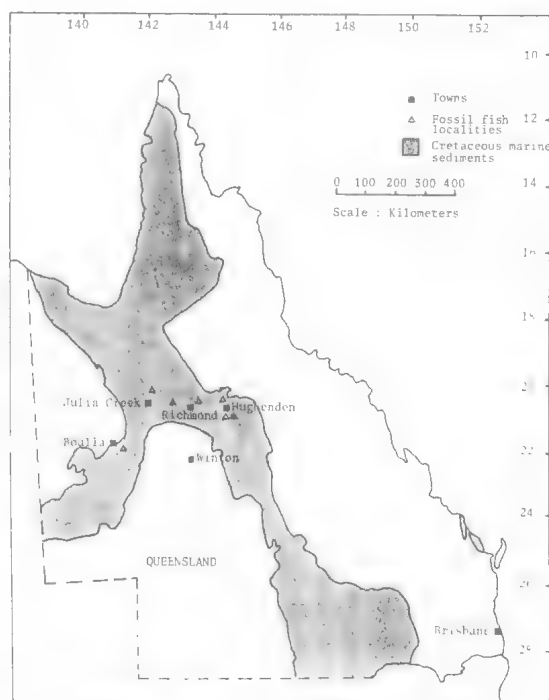


FIG. 1: Localities from which *Cooyoo australis* specimens have been collected.

Sphenotics project laterally tapering to truncated points; sphenotics directed lateroventrally in *Xiphactinus* and anteroventrally in *Ichthyodectes*.

Large, ventrally directed hyomandibular fossa lies obliquely across lateral surface of neurocranium, spanning the sphenotic, prootic, pterotic and intercalar; its posterior portion is obscured by a wing of pterotic. Hyomandibular fossa is orientated horizontally in both *Xiphactinus* and *Ichthyodectes*. Located directly below the hyomandibular fossa is large, rhomboidal, subtemporal fossa, posteroventral margin of which is formed by slanted, prootic-intercalar bridge.

Above hyomandibular fossa on pterotic is a depression forming the lateral temporal fossa; dorsal margin of this fossa rises from midpoint of hyomandibular fossa, extending upward in an arc ending on frontals.

Teeth are medium to small (mean height 4 mm); size range within a jaw is low. In *Xiphactinus* the teeth are large (1–4 cm) and variable in size. In

Ichthyodectes the teeth have a mean height of 8 mm and show little size variation.

Premaxillary basically rectangular, elongated dorsoventrally; its dental margin is curved and bears six alveoli. *Xiphactinus* has an ovate premaxillary with a straight dental border; 5–6 alveoli are present. In *Ichthyodectes* the premaxillary is rhomboidal or ellipsoidal in profile with a mean number of 6.6. alveoli.

RANGE

All material with detailed locality information has been collected from either the Toolebuc Formation or Allaru Mudstone, both of which are Lower Cretaceous (Albian) age (Day *et al.*, 1983), not as suggested by Bardack (1965) Upper Cretaceous.

ETYMOLOGY

The name means fish in the Pooroga language spoken by the Jarambali Aborigines who lived in the Upper Flinders, Hughenden and Dutton River districts (Curr and Curr 1887).



FIG. 2: *Cooyoo australis*. Lateral aspect of neurocranium from specimen QMF 12325.

Cooyoo australis (Woodward, 1894)

Portheus australis Woodward, 1894, pp. 444-7, pl. 10; Longman, 1913, pp. 95-4; Wade, 1930, p. 143; David, 1950, p. 499; Hills, 1958, p. 99.
Xiphactinus australis (Woodward, 1894); Bardack, 1965, p. 54; Hill, Playford and Wood, 1968, pl. K XII (1); Long, 1982, p. 71.

MATERIAL

Holotype, GSQ2445 Portion of upper and lower jaw, Clutha Station, near Hughenden, 5 km from Home station on Gidgery Creek. Fm.: Allaru Mudstone. Age: Lower Cretaceous, Albian. Referred specimens all of Albian age: QMF354, partial skull, Hughenden, near Flinders River; QMF1016, skull, six miles northeast of Richmond; QM F2581, vertebrae and ribs, 'Lydia Downs', Nelia; QMF6346, skull and vertebrae, 'Laura Downs', Julia Creek, at M.R. 465493 Julia Creek 1:125,000. Allaru Mudstone; QMF9466, skull, Stuart Creek, Hughenden; QMF9468, skull, Dinga Ding Station, near McKinlay, Allaru Mudstone; QMF9469, skull, 'Boree Park', near Richmond; QMF9471, vertebrae, 'Dinga Ding Station', near McKinlay, Allaru Mudstone; QMF9472, skull, 'Dinga Ding Station', near McKinlay, Allaru Mudstone; QMF12325, neurocranium, 'Warra Station', near Richmond, Toolebuc Formation; QMF12327, skull, fin and vertebrae, Pelican Bore, Stewart Creek, 'Dunraven Station', near Hughenden, Toolebuc Formation; QMF12710, partial skull, 'Arrara Station', near Hughenden North-west or Weather Paddock, Allaru Mudstone; QMF12711, skull, Mountain Creek, 'Redcliffe Station', near Hughenden, Allaru Mudstone.

DIAGNOSIS

As for the genus.

DESCRIPTION

While most of the skeleton of the species is known, certain cranial elements — vomer, orbital bones, supramaxillary bones — and certain caudal elements — pectoral girdle and pelvic and caudal fins have not, as yet, been recorded.

NEUROCRANIUM (Figs 2-4): incomplete, with the vomer unknown and ethmoid and parietal only partially known. Basically wedge-shaped, with the base formed by stout parasphenoid and dorsal roof by ethmoid, frontals, parietals and supraoccipital.

SUPRAOCCIPITAL (Figs 2-4, 6): forms triangular-shaped crest rising from posterior margin of parietals above dorsal surface of neurocranium at an angle of approximately 15° (5 specimens); viewed laterally, posterior margin of crest appears concave; viewed posteriorly, supraoccipital crest forms dorsal pinnacle, crowning neurocranium, from which it extends ventrally to contribute to formation of large subepiotic fossae; at base of

crest, supraoccipital expands laterally to join epiotics.

EPIOTIC (Figs 2-4, 6): crests approximately a quarter height of supraoccipital crest; supraoccipital — epiotic suture runs along median side of epiotic ridge, just below its crest; epiotics also form dorsal corners of the posterior surface of neurocranium and contribute to formation of large subepiotic fossae and post-temporal fossae.

PARIETALS (Figs 2, 3, 6): fused medially, lying anterior to supraoccipital crest; relatively small bones forming a dome at midline of dorsal neurocranial surface. They extend posteriorly around the anterior base of supraoccipital crest and carry anterior extensions of epiotic crests; dorsally, surface unornamented.

FRONTALS (Figs 2, 3, 6): large, extending from anterior parietal margins to cover nearly a third of dorsal neurocranial surface. Each bears prominent ridge originating at anterior margin of parietals, just below dorsal midpoint of neurocranium; these gradually diverge anteriorly, curving along dorsolateral margin of frontals, roofing orbits and then reconverging anteriorly; between ridges,



FIG. 3. *Cooyoo australis*. Dorsal aspect of neurocranium from specimen QMF 12325.

smooth frontals rise gently to form broad ridge at their common suture; each exhibits laterally directed triangular shelf, midway along dorsolateral margin; anterior margins of frontals obscured or damaged. The anterior border of the frontals is probably formed by the ethmoids and parethmoids.

ETHMOIDS (Fig. 6): imperfectly known; suture with frontals obscured but, anteriorly, they appear to exhibit beak-like rounded margin; at anterolateral corner of ethmoid is ventrally directed process appearing to articulate with dorsal surface of palatine head; anteroventrally, each contributes to deep lateral fossa, probably to accommodate premaxillary ligaments.

PARETHMOIDS: lie ventral to ethmoids and frontals; each contributes to lateral fossa; they also form lateral wall of nasal capsule and portion of anterior margin of orbit; anteroventral surface forms large concave condyle articulating with saddle-shaped surface of palatine head.

SPHENOTICS (Figs 2, 3, 6): situated at posterior ventrolateral corner of frontals; posteriorly, they meet pterotics and ventrally are bound by prootics; they exhibit laterally directed projection tapering to truncated point; posteroventral portion of sphenotic forms anterolateral corner of hyomandibular fossa.

HYOMANDIBULAR FOSSA (Fig. 2): large, elongate, opening ventrally, running obliquely across almost entire length of otic section of neurocranium, spanning four separate bones;

sphenotic and prootic form elevated anterior corner of fossa, intercalar forms lower posterior corner, while pterotic comprises bulk of fossa and laterally obscures most of its posterior portion.

PTEROTICS (Figs 2, 3, 6): large, covering much of lateral surface of brain case; dorsally, bounded by parietal and epiotic, ventrally by prootic, posteriorly by intercalar and anteriorly, extend to meet sphenotic ventrally and frontal dorsally; as well as containing most of hyomandibular fossa, pterotics also bear lateral temporal fossa and roof of subtemporal fossa; dorsal margin of lateral temporal fossa forms an arc running from midway along ventral margin of pterotic, forward to posteroventral corner of frontals; pterotics also forms at least half lateral margin of posterior surface of the neurocranium; combined with epiotic and exoccipital bones, contributes to large, posterior, post-temporal fossa.

SUBTEMPORAL FOSSA (Fig 2): large, well developed and rhomboidal; roof formed by the pterotic, but mostly contained by prootic and intercalar; the prootic and intercalar form bridge lying obliquely across posteroventral margin of fossa.

INTERCALAR (Figs 2, 3): large, forming posteroventral neurocranial corner; bounded ventrally by exoccipital and anterodorsally by pterotic; posteriorly, meets exoccipitals; together forming foramen for vagus and glossopharyngeal nerves and lateral head vein.

PROOTIC (Figs 2-4): anterior to intercalar and basioccipital bones, forming most of anterodorsal portion of subtemporal fossa; covers nearly half lateral face of brain case and incorporates two foramina, one leading into prootic canal and other for hyomandibular branch of 7th nerve.

BASIOCCIPITAL (Figs 2, 4): positioned posterior to prootic but ventral to intercalar, forming posteroventral corner of brain case; lateral surface of basioccipital markedly concave to accommodate branch of swim bladder.

EXOCCIPITALS (Figs 2, 4): form most of ventral portion of posterior face of neurocranium; laterally they are barely visible, sandwiched between intercalar dorsally and basioccipitals ventrally; posteriorly, contribute to subepiotic fossa and together form foramen magnum; fused to medial ventral surface is half a vertebra.

PARASPHENOID (Figs 2, 6): strong, elongate, lying ventral to basioccipital and prootic, forming base of brain case; transversely, beneath orbit it has sharply convex dorsal surface and gently convex ventral surface; beneath brain case, parasphenoid divides posteriorly into two arms,



FIG. 4: *Cooyoo australis*. Posterior aspect of neurocranium from specimen QMF 12325.

triangular in cross section with concave lateral surfaces; arms taper posteriorly, terminating in points at posterior end of brain case; stout basiptyergoid processes present, extending anterolaterally just anterior to otic section of neurocranium; anterior portion of parasphenoid not preserved and relationship with vomer cannot be ascertained; parasphenoid flexes upward at junction of otic and orbital sections of neurocranium; with mean angle of flexure approximately 149° (3 specimens).

PREMAXILLARY (Fig. 6): rarely preserved, suggesting that ligamentous attachments not very strong; a relatively large, robust bone sub-rectangular in outline; oral border curved, with six alveoli, at least four bearing teeth.

MAXILLARY (Fig. 6): long, fairly shallow, narrowing posteriorly; anterodorsal margin with hammer-like condyle articulating with malleolar

head of palatine; anterior to condyle, maxillary shows another, smaller condyle abutting a facet formed by vomer and ethmoid; ventral edge of maxillary essentially straight, containing variable number of teeth (Table 1); teeth may occur in every alveolus or every second alveolus; Table 2 shows range in tooth size and number found; teeth not very large (mean 4 mm) and, within an individual, show only small range in height; lateral maxillary surface flat, showing little ornamentation, except just below dorsal surface maxillary where distinct groove accommodated ventral margin of supramaxillary bones; posterior end of maxillary not well preserved, but exhibits dorsal swing with ventral margin resting in groove in quadrate.

SUPRAMAXILLARY: bones thin, fragile, poorly preserved; shape difficult to determine, probably comprising smaller, almost ovoid posterior bone and larger, rectangular, anterior bone, dorsal

TABLE 1. Number of alveoli and tooth size observed in the maxillary of specimens of *Cooyoo australis*. The size of the sample limits the amount of interpretation possible, however the size of the standard deviations clearly indicates how little tooth size varies in a single specimen.

MAXILLARY							
Specimen	Alveoli No. Left Right		Teeth No. Left Right		No. of complete teeth measured	Mean Size (cm)	SD
QMF10209	27 +	38 (anterior damaged)	14 +	26 (anterior damaged)	17	0.369	± 0.155
QMF1016	38	32	28	22	All teeth broken		
QMF6346	34	not visible	23	not visible	8	0.409	± 0.05
QMF12327	34	not visible	17	not visible	10	0.45	± 0.107

TABLE 2. Number of alveoli and size of teeth observed in the dentary specimens of *Cooyoo australis*.

DENTARY					
Specimen	Alveoli No. Left Right		Teeth No. Left Right		Sizes (cm)
QMF10209	Tooth row obscured by Maxillary				
QMF1016	20	posterior end broken	11	11 +	0.75,0.94,0.86 most teeth broken
QMF6346	Most teeth obscured or broken				0.9,0.54,0.59,0.72
QMF12372	Most teeth obscured or broken				0.8,0.36,0.49,0.52
GSQ2445	Most teeth broken				0.99,1.08

margin of which seems to be convex.

DENTARY (Fig. 6): fairly stout, deep, bearing single row of medium-sized teeth (mean 7 mm); teeth almost uniform size, except in QMF12327 where first few teeth larger and broader than rest; dental margin rises to peak just before posterior end of bone; posterior to peak, margin plunges steeply downward to anterodorsal margin of angular; angular then flexes dorsally to articulate with quadrate; most of ventral margin of dentary straight, but flexes dorsally below angular; no internal view of dentary available. Table 2 shows ratio of mandibular length to depth; ratio difficult to measure because of poor preservation of bones and comparison with other genera should be treated with caution.

HYOMANDIBULAR (Figs 5, 6): largest of hyopalatine bones; dorsally, 'dumbbell'-shaped head articulates with hyomandibular fossa; posterior hyomandibular margin forms gently curving raised rim, edging posterior margin of skull and articulating with preopercular; anterior to rim, hyomandibular markedly concave; concave portion covered by postorbitals.

METAPTERYGOID (Figs 5, 6): anterior to hyomandibular; large, right-angle shaped element, bounded by quadrate posteroventrally, ectopterygoid anteroventrally and mesopterygoid anteriorly; it makes no contribution to boundary of orbit, formed by the palatine, mesopterygoid and hyomandibular.

MESOPTERYGOID (Figs 5, 6): comparatively small, wedged between hyomandibular and palatine, and dorsal to metapterygoid; despite small size, it forms almost half margin of orbit; at

junction with hyomandibular is groove for basiptyergoid process.

PALATINE (Figs 5, 6): lies anterior to mesopterygoid; it possesses distinct malleolar head; dorsal surface of head peaked, articulating with ventrally grooved parethmoid; ventral palatine surface concave accommodating condyle on dorsal edge of maxilla.

ECTOPTYERGOID (Figs 5, 6): ventral to palatine, anterior to metapterygoid and dorsal to quadrate; elongate, forming ventral margin of



FIG. 5: *Cooyoo australis*. External view of hyomandibular bones. Reconstructed based on specimens; QMF 1016, QMF 12327, QMF 12711.

TABLE 3. Measurements of maxillary and dentary length and depths observed in specimens of *Cooyoo australis*.

Specimen	Maxillary		Dentary	
	Length (cm)	Depth (cm)	Length (cm)	Depth (cm)
QMF10209	6.2 (approx)	posterior condyle obscured	5.27	3.18
QMF1016	8.46	1.34	5.5	3.75
QMF6346	8.54	1.98	5.34 (?) obscured	4.3 (?)
QMF12327	9.56	1.87 (approx)	6.71 (?) obscured	4 (?)

Maxillary length measured from posterior margin of premaxillary to last alveolus.

Maxillary depth measured at posterior condyle.

Dentary length of alveolar border.

Dentary depth measured at coronoid process

hyomandibular apparatus; anteriorly, it has interdigitating suture with palatine; posterior margin and its relationship with hyomandibular difficult to determine as usually broken and distorted.

QUADRATE (Figs 5, 6): articulates with ventral margins of ectopterygoid, metapterygoid and hyomandibular; triangular, with ventral apex forming articulating head for the jaws; posterior margin of the maxilla lies in groove on this condyle and angular portion of lower jaw articulate with it.

SYMPLECTIC: small, splinter-like lying near posterior margin of quadrate.

CIRCUMORBITALS: not preserved in most specimens and, at best, only partially preserved; fragmentary evidence indicates probably six circumorbital plates - dermosphenotic, two supraorbitals, lacrymal, infraorbital and a large postorbital which, when preserved, mask much of hyopalatine bones.

SCLEROTIC (Fig. 6): bones, frequently preserved; most specimens exhibit two sclerotic bones ringing eye; basal sclerotic also frequently preserved, found at bottom of eye capsule; basal sclerotic fairly thick, heavy bone exhibiting delicately spined margin and posteriorly positioned, keyhole-shaped indentation.

PREOPERCULAR (Fig. 6): elongate dorso-ventrally with an expanded ventral base bearing 13 sensory canal openings; dorsal margin appears obliquely truncated, with highest point occurring anteriorly.

OPERCULAR (Fig. 6): large, flat, abutting against posterior margin of preopercular and having a semicircular posterior margin.

Pectoral girdle and fins poorly represented. They are known only from one piece of cleithrum, a fragmentary pectoral fin and a fragmentary pelvic fin.

CLEITHRUM: robust, L-shaped.

PECTORAL FIN: exhibits nine fin rays. These are

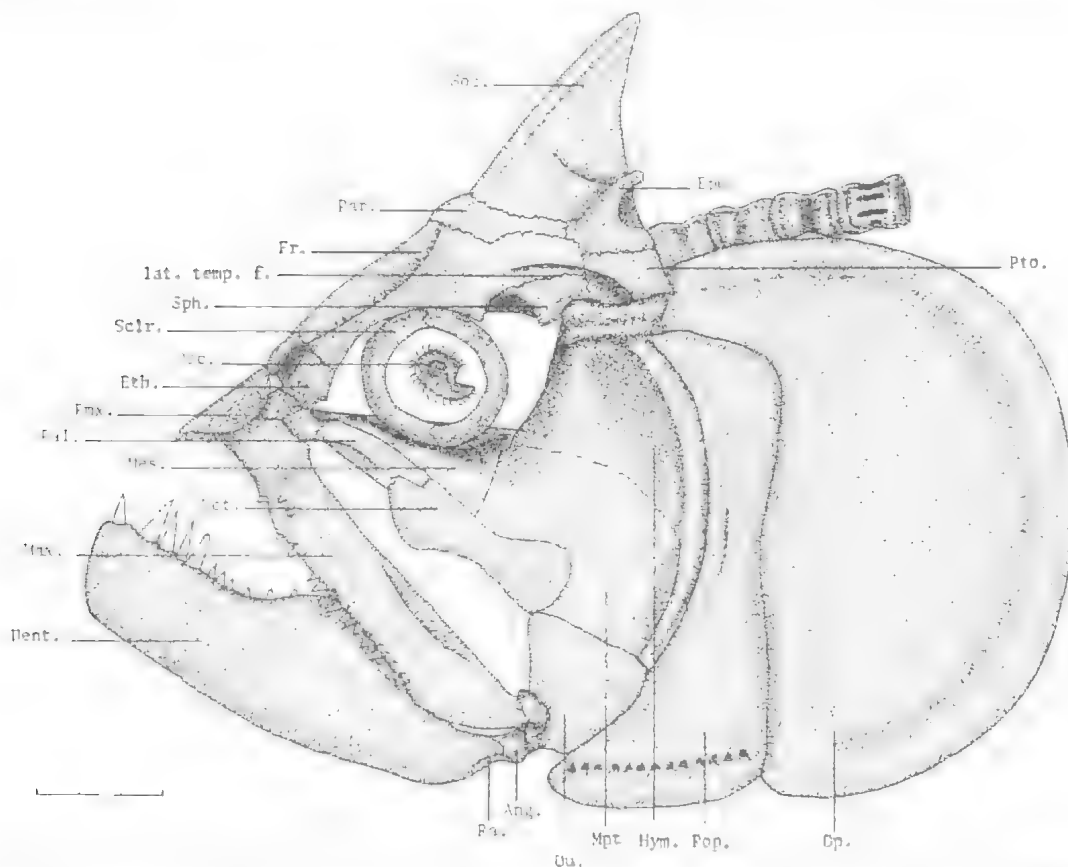


FIG. 6: *Cooyoo australis*. Partial reconstruction of head. Based on specimens; QMF 1016, QMF 12325, QMF 12327, QMF 12711.

both broad and thick, especially the most posterior ray which is almost twice the width of the others.

PELVIC FIN: is poorly preserved, exhibiting 7 broad fin rays.

A complete vertebral column and caudal skeleton has yet to be collected. It is particularly unfortunate that no tail has yet been found. The most complete skeleton possesses 65 vertebrae.

VERTEBRAE (Fig. 6): exhibit laterally a longitudinal ridge separating two deep, longitudinal grooves. This character is not apparent in the first few vertebrae which are laterally smooth; grooves also occur on the dorsal; ventral surfaces of the vertebrae receiving the heads of neural and haemal arches.

REMARKS

Specimens of *Cooyoo australis* examined in this study show little variation in the morphology of bones constructing the skull. The bone shape and relative proportions appeared to remain essentially constant regardless of the overall size of the individual.

The vertebrae (QMF6139 from Station Creek, Aston Downs, Queensland) assigned questionably by Woodward (1894) to *Cladocyclus sweeti* (?) are obviously ichthyodectiform but are not considered diagnostic to a generic level.

PALAEOECOLOGY

Cooyoo australis has only been collected from sediments which are regarded as the deposits of a shallow marine environment (Day *et al.* 1983). It is found in association with marine vertebrates such as ichthyosaurs, plesiosaurs, other actinopterygians and sharks, and marine invertebrates such as ammonites, belemnites, and crustaceans. Also occurring in the deposits are the remains of terrestrial vertebrates such as dinosaurs and occasional terrestrial plants and insects which indicate proximity to the shore line.

Cooyoo australis is one of the fish most commonly collected from these sediments. This suggests that it was quite an abundant member of the ichthyofauna. Its streamlined body, powerful fins and numerous sharp teeth indicate that, like other ichthyodectiforms, it was predacious.

COMPARISONS AND GENERIC DESIGNATION

Nine genera were previously recognized as forming the family Ichthyodectidae (Patterson and Rosen 1977). These are *Ichthyodectes*, *Xiphactinus*, *Gillicus*, *Eubiodectes*, *Proportheus*, *Chirocentrites*, *Thrissops*, *Spathodactylus* and *Cladocyclus*. Of these, *Spathodactylus* is known only from a single poorly preserved specimen; *Chirocentrites* is possibly *Xiphactinus*; similarly *Proportheus* may be synonymous with *Cladocyclus*; *Thrissops* may be synonymous with *Gillicus*, and *Eubiodectes* equivalent to *Ichthyodectes* (Patterson and Rosen 1977). Because of these uncertainties, and because it is not possible to examine any of this material, *Cooyoo* will only be compared with the four accepted and fairly well known, figured and described genera, namely *Xiphactinus*, *Cladocyclus*, *Gillicus*, and *Ichthyodectes*. Comparisons will only be made at the generic level as the characters which have been used to separate species within a genus are minor. Most species are



FIG 7: *Cooyoo australis* — Holotype — GSQ 2445
Portion of upper and lower jaw. Scale bar = 2cm.

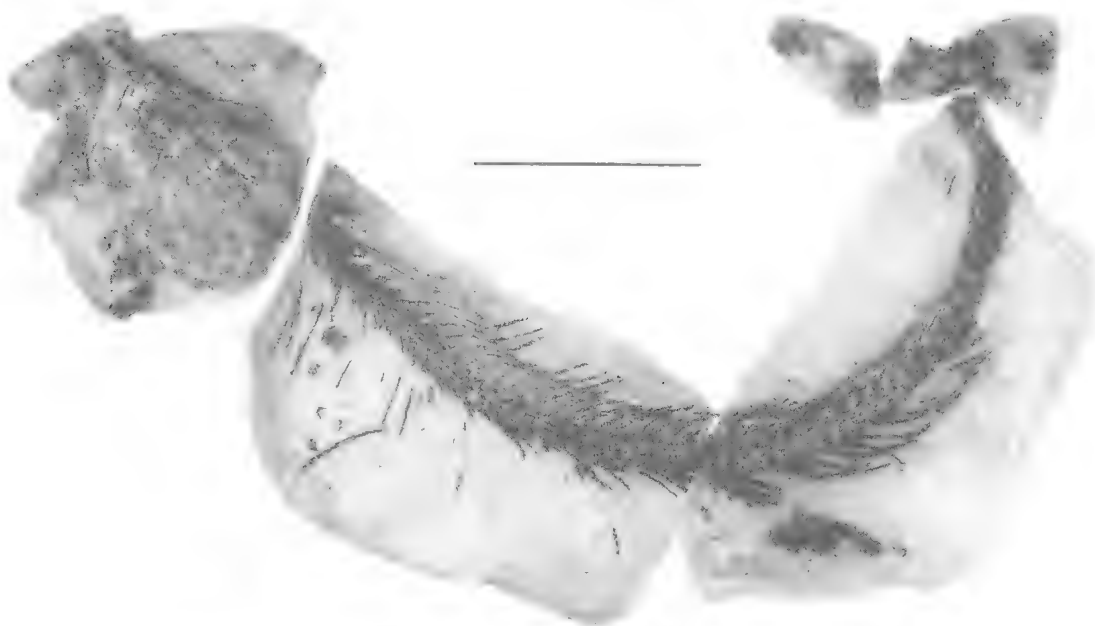


FIG 8: *Cooyoo australis* — QMF 6346. Most complete specimen collected to date. Scale bar = 20cm.

FIG 9: *Cooyoo australis* — QMF 12325 — An almost perfect neurocranium. A. Lateral view. B. dorsal view. C. posterior view. Scale bar = 1cm.

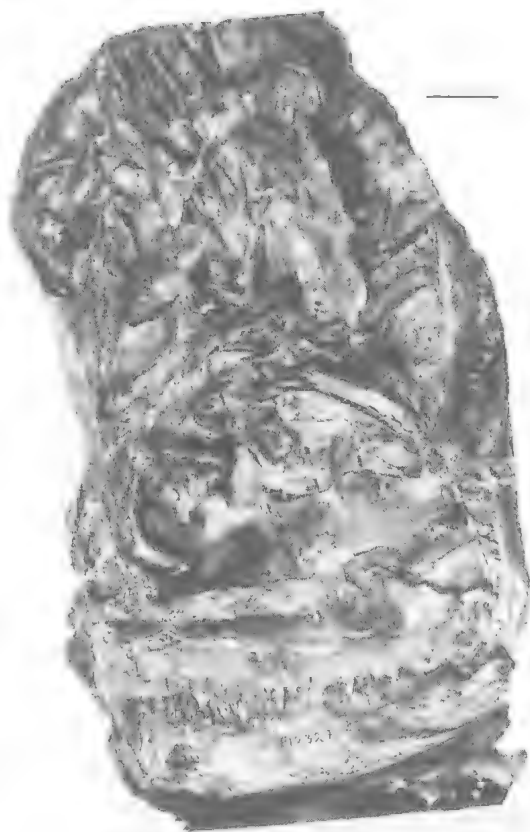
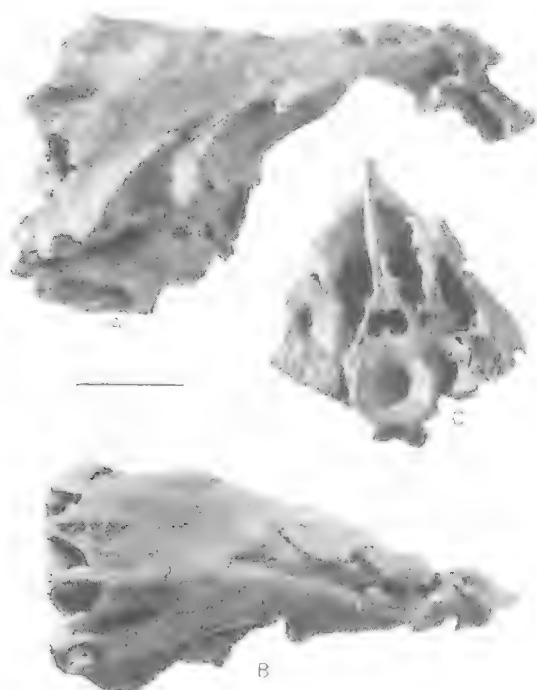


FIG 10: *Cooyoo australis* — QMF 12327 — Skull with portion of the pectoral girdle. Scale bar = 2cm.

distinguished only on geographic grounds. For example, Bardack (1965) writes 'The four species *Xiphactinus audax*, *X. mantelli*, *X. gaultinus* and *X. australis*, tentatively retained in this revision, are distinguished primarily for reasons of geographic distribution rather than for morphologic differences.'. Comparisons made herein are based on the figures and descriptions given by Stewart (1900) and Bardack (1965) for *Xiphactinus*, *Ichthyodectes* and *Gillicus*, and by Patterson and Rosen (1977) for *Cladocyclus*.

Although these comparisons strive to be as rigorous as possible, they are limited by the fact that only rarely are entire fish preserved or even representatives of all skeletal elements collected. For example, in the case of *Cooyoo*, almost no caudal skeletal elements have been collected and no comparisons of the tail skeletons are possible.

An additional bias is that certain skeletal elements are so fragile that they are rarely preserved while the more robust predominate in the fossil material. Despite these difficulties it is considered that the material available is sufficient to define accurately the relationship of *Cooyoo* to other ichthyodectids.

Of the four most probable genera into which *Cooyoo* may have been placed, *Gillicus* and *Cladocyclus*, are obviously distinct. Main differences between *Gillicus* and *Cooyoo* are: (1) *Gillicus* possesses minute teeth less than 1mm high while in *Cooyoo* the teeth are relatively more robust with a mean height of 4mm; (2) *Gillicus* has a curved dental border, while the dental border in *Cooyoo* is straight; (3) the premaxillary of *Gillicus* contains 10–17 alveoli, considerably more than the 6 observed in *Cooyoo*; (4) in *Gillicus*, the

TABLE 4. Summary of major similarities (S) and differences (D) between *Cooyoo*, *Xiphactinus* and *Ichthyodectes*.

Feature	<i>Xiphactinus</i>	<i>Cooyoo</i>	<i>Ichthyodectes</i>
Angle of rise of Supraoccipital Crest	D 30 degrees	D 15 degrees	D 39 degrees
Proportional Height of Epitotic crests	D	S	S
Parietals Ornament Shape	D S	S S	S D
Frontals Ridges Flange	D D	D D	D D
Ethmoid shape	D	S	S
Sphenotic shape	D	D	D
Hyomandibular fossa orientation	D	D	D
Subtemporal fossa orientation	D	D	D
Lateral temporal fossa, size and shape	D	D	D
Basisphenoid Flexure	D 160	S 149	S 149
Cross-sectional shape Division	S D	S D	D D
Premaxillary Shape Number of alveoli	D D	D S	D S
Maxillary Teeth size Number of alveoli	D S	D S	D D

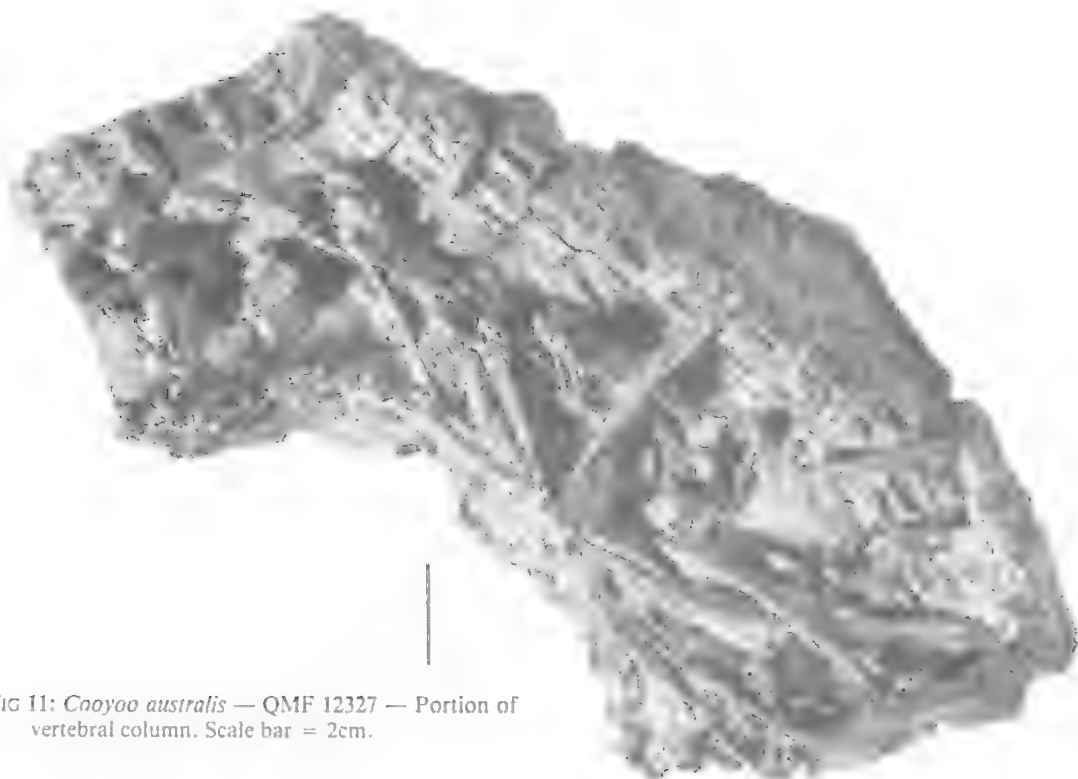


FIG 11: *Cooyoo australis* — QMF 12327 — Portion of vertebral column. Scale bar = 2cm.

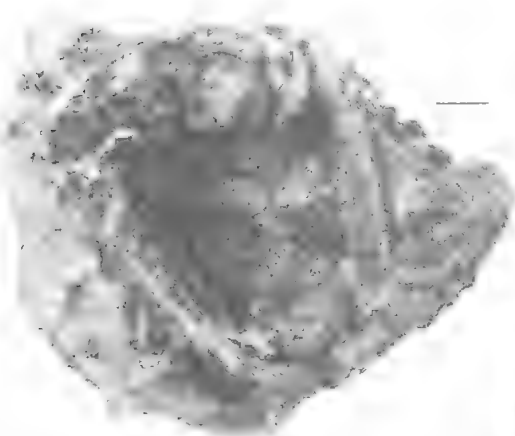


FIG 12: *Cooyoo australis* — QMF 12711 — Skull (right side) clearly showing the hyomandibular fossa. Scale bar = 2cm.

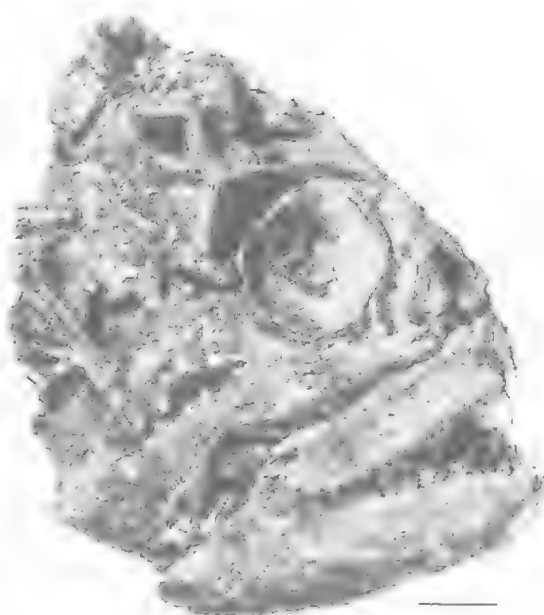


FIG 13: *Cooyoo australis* — Skull (right side). This specimen exhibits the basiclerotic plate, typical of ichthyodectiformes. Scale bar = 2cm.

parasphenoid angles sharply upward beneath the midpoint of the otic section of the neurocranium. In *Cooyoo* this flexure is very slight. In addition, the parasphenoid of *Gillicus* is quadrilateral in cross-section, while in *Cooyoo* it is triangular; (5) the lateral temporal fossa of *Gillicus* extends onto the sphenotic and is much smaller than the one observed in *Cooyoo* which extends onto the frontals; (6) in *Cooyoo* the hyomandibular fossa is tilted upward anterodorsally, opposite to that observed in *Gillicus* which tilts up posterodorsally; (7) in *Cooyoo* the hyomandibular fossa opens ventrally with most of the posterior portion being obscured by the pterotic; in *Gillicus* the fossa opens laterally and is not obscured at all; (8) in *Gillicus*, the subtemporal fossa is ovate in shape and proportionally smaller than the diamond shaped fossa found in *Cooyoo*; (9) in *Cooyoo*, the frontals bear strong curved ridges; comparable ridges are very weak in *Gillicus*; (10) in *Gillicus*, the ethmoid is club shaped, while in *Cooyoo* it ends in a rounded beak; and (11) in *Gillicus*, the sphenotics are forward directed hooks, while in *Cooyoo* they are simple, truncated points.

Main differences between *Cooyoo* and *Cladocyclus* are: (1) the parietals of *Cladocyclus* extend further forward down the midline of the neurocranium than those of *Cooyoo*; (2) the frontals of *Cladocyclus* do not, as in *Cooyoo*, exhibit curved ridges or a laterally extended shelf; (3) the ethmoids are broader and more rounded in *Cladocyclus* than in *Cooyoo*; (4) the sphenotics of *Cladocyclus* exhibit a posteriorly directed hook not seen in *Cooyoo*; (5) *Cladocyclus* exhibits an 'L'-shaped preopercular which tapers dorsally ending in a truncated point quite distinct from the broad, blunt, dorsal margin found in *Cooyoo*; (6) in *Cladocyclus* the premaxillaries appear to be proportionally shorter antero-posteriorly than those of *Cooyoo*; (7) the pterotics in *Cladocyclus* show an undulating suture with the frontals; in *Cooyoo*, this suture is straight; in addition, the pterotics of *Cladocyclus* do not appear to obscure the posterior portion of the hyomandibular fossa; (8) the epiotic crests of *Cladocyclus* are much smaller than those in *Cooyoo*, where the epiotic crests extend almost to the posterior margin of the supraoccipital crest; in *Cladocyclus*, the epiotics seem to be only half the antero-posterior length of the supraoccipital crest.

Of the other two genera, *Xiphactinus* and *Ichthyodectes*, the following comparison reveals that *Cooyoo* shows affinities with both genera but is sufficiently distinct from each to warrant separate generic status.

Comparison of *Cooyoo* with *Xiphactinus* reveals the following significant differences:

(1) the supraoccipital crest in *Xiphactinus* and *Cooyoo* commences on the parietals and exhibits a gradual rise from the dorsal surface of the neurocranium. The two genera differ significantly in the mean angle of flexure of this rise. In *Xiphactinus*, the mean angle of flexure is 30°. In *Cooyoo*, the angle is significantly less, the mean being only 15° (5 specimens).

(2) the relative height of the epiotic crests compared to that of the supraoccipital crest differs between *Xiphactinus* and *Cooyoo*; in *Xiphactinus*, the epiotic crest is approximately one-third the height of the supraoccipital crest; in *Cooyoo*, the relative height of the epiotic crest is only approximately one-quarter the height of the supraoccipital crest.

(3) the fused parietals of *Xiphactinus* exhibit 'An elongate cluster of small knobs...' (Bardack 1965, p.37) but the parietals in *Cooyoo* are unornamented. The construction of the parietals in *Xiphactinus* and *Cooyoo* is similar. In both, the parietals extend posteriorly some distance on either side of the supraoccipital crests. In *Cooyoo*, the parietals also form the anterior portion of the epiotic crests.

(4) the frontals in *Xiphactinus* are quite distinct from those in *Cooyoo*; in *Xiphactinus*, the dorsal surface of the frontal exhibits a broad shelf extending laterally above the orbit; the frontals of *Cooyoo* dorsally exhibit distinct ridges commencing at the base of the parietals and curving anterolaterally to form the dorsolateral margin of the frontals above the orbit.

(5) the ethmoids have been obscured or damaged in all known specimens of *Cooyoo*; thus, only a general comparison is possible with those of *Xiphactinus*; it seems that the ethmoids in *Cooyoo* terminate anteriorly in a "beak" contrasting with the rounded anterior margin in *Xiphactinus*.

(6) the sphenotics in *Cooyoo* and *Xiphactinus* are similar in shape; however, in *Xiphactinus*, they are orientated lateroventrally, while in *Cooyoo* they are directed laterally.

(7) the hyomandibular fossa also differs significantly in the amount that this fossa is obscured by the pterotics; in *Xiphactinus*, the fossa appears to open laterally, with the pterotic only forming the roof of the fossa and apparently not obscuring the opening of the fossa; in *Cooyoo*, the opening of the hyomandibular fossa faces ventrally; viewed laterally, the hyomandibular fossa is almost totally obscured; additionally, the fossa is not, as in *Xiphactinus*, horizontal; it slopes

obliquely from dorsal to ventral anteroposteriorly across the lateral surface of the neurocranium in *Cooyoo*.

(8) in *Xiphactinus*, the subtemporal fossa is quite large and rectangular, approximately two-thirds the length of the hyomandibular fossa in size, and is located below the middle of the hyomandibular fossa; the prootic-intercalar bridge forms the ventral margin of the fossa; the size of the fossa in *Cooyoo* is comparable to that found in *Xiphactinus*; however, its rhomboidal shape gives it a distinctly different orientation to that in *Xiphactinus*; in *Cooyoo*, the prootic-intercalar bridge forms the posterior ventral edge of the fossa and consequently, lies at an angle to the horizontal, tilting up posteriorly; this is quite distinct from the horizontal orientation of this bridge in *Xiphactinus*.

(9) in *Xiphactinus*, the lateral temporal fossa is confined to the pterotic and is formed as a depression just above the hyomandibular fossa; the dorsal rim of this depression rises gently from approximately the midpoint of the hyomandibular fossa to end just before the midpoint of the suture between the pterotic and the frontals. Posterior to the point above the hyomandibular fossa where this edge begins to slope upward, the rim flexes downward and then up again so that the pterotic forms a wing just above the middle of the hyomandibular fossa. The lateral temporal fossa in *Cooyoo* is very strongly developed, the roof of the fossa extending forward from the base of the pterotic up onto the frontals. The wing, formed by the pterotic above the hyomandibular fossa, completely obscures the posterior half of the fossa.

(10) the parasphenoid differs between *Cooyoo* and *Xiphactinus* in two main ways. Firstly, the amount of flexure exhibited between the otic and orbital sections of the bone is different, with *Xiphactinus* exhibiting a mean flexure of 160° , considerably more than the mean of 149° in *Cooyoo*. Secondly, the relative position of the division of the basisphenoid differs between *Xiphactinus* and *Cooyoo*; in *Xiphactinus*, this division occurs below the posterior end of the prootic, while in *Cooyoo*, it is below the anterior end of the prootic.

(11) the premaxillary is only present in a single specimen of *Cooyoo*, suggesting its attachment to the maxillary was weak; the premaxillary is roughly rectangular with a curved alveolar border bearing 6 alveoli and at least 4 teeth. In *Xiphactinus*, the premaxillary is ovate, with a straight dental margin bearing 5-6 alveoli, usually containing 2 teeth (Bardack 1965); it is reported as

being firmly attached to the maxillary (Bardack 1965).

(12) the size of the maxillary teeth and the number of alveoli differs between the genera. In *Xiphactinus*, the teeth are large and variable in size, 1-4cm, while the average number of alveoli is 32; the teeth of *Cooyoo* are much smaller, having a mean size of 4mm, usually with little variation in size; the number of alveoli, 34, is similar to *Xiphactinus*.

(13) comparison of the hyomandibular apparatus reveals a number of differences, namely: in *Xiphactinus*, the mesopterygoid forms about one-third of the margin of the orbit, compared to *Cooyoo* in which it forms approximately one half the margin of the orbit; in *Xiphactinus*, the dorsal margin of the ectopterygoid, adjoining the metapterygoid, is straight and on the same line as the dorsal margin of the quadrate; in *Cooyoo*, this margin curves gently upward posteriorly, suddenly dropping down where the ectopterygoid meets the quadrate; and in *Xiphactinus*, the palatine head exhibits laterally directed flanges, which are absent in *Cooyoo*.

(14) the dorsal margin of the preopercular in *Cooyoo* and *Xiphactinus* differ in being blunt in *Cooyoo* and stepped in *Xiphactinus*.

Comparison of *Cooyoo* with *Ichthyodectes* reveals the following significant differences.

(1) the supraoccipital crest rises much more sharply above the surface of the neurocranium in *Ichthyodectes* (mean angle of flexure 39°) than in *Cooyoo* where the mean angle of flexure is only 15° .

(2) the fused parietals in *Ichthyodectes* do not exhibit the posterior extensions which form the bases of the epiotic crests in *Cooyoo*.

(3) the frontal ridges in *Ichthyodectes* are less distinct, being somewhat flattened and curve the opposite way to those in *Cooyoo*.

(4) the sphenotics in *Ichthyodectes* are anteroventrally directed with a sub-triangular shape, laterally, quite distinct from the truncated point in *Cooyoo*.

(5) the posterior end of the hyomandibular fossa in *Ichthyodectes* is partially obscured by a wing of the pterotic; the fossa opens laterally and is orientated parallel to the horizontal. This is quite different from the almost totally obscured, ventrally opening, obliquely orientated fossa in *Cooyoo*.

(6) the subtemporal fossa in *Ichthyodectes*, compared to *Cooyoo*, is proportionately smaller, approximately one-third the length of the

hyomandibular fossa; it is different in shape, being basically ovate in *Ichthyodectes* and rhomboidal in *Cooyoo*; and it differs in the orientation of the prootic bridge, which is horizontal and bounds only the posterior half of the ventral margin of the fossa in *Ichthyodectes*, in *Cooyoo*, it is slanted, forming the posteroventral corner of the fossa.

(7) the lateral temporal fossae are not as strongly developed in *Ichthyodectes* as that in *Cooyoo*.

(8) the parasphenoids in *Cooyoo* and *Ichthyodectes* differ in the relative position of the division which, in *Ichthyodectes*, occurs below the middle of the prootic, whereas in *Cooyoo*, it divides below the anterior end of the prootic; also, in *Ichthyodectes* the ventral surface is flat, while in *Cooyoo* it is curved.

(9) the maxillary teeth in *Ichthyodectes* (mean size of 8mm) are larger than those in *Cooyoo* (mean size 4 mm) while the average number of alveoli in *Ichthyodectes* (mean number 48) is higher, compared with the 34 in *Cooyoo*.

(10) the preoperculars in *Ichthyodectes* and *Cooyoo* differ in the nature of their dorsal margins; in *Cooyoo*, the margin is blunt, while in *Ichthyodectes* it narrows to a sharp point.

(11) the number of fin rays in the pectoral fin in *Ichthyodectes* and *Cooyoo* is different. *Ichthyodectes* possesses 11 fin rays while *Cooyoo* possesses 9.

DISCUSSION

The ichthyodectiform genera *Ichthyodectes*, *Gillicus*, *Cladocycilus* and *Xiphactinus* represent a group of closely related Mesozoic fish (Bardack 1965; Patterson and Rosen 1977; Bardack and Sprinkle 1969). *Cooyoo australis* is clearly closely related to this group. A comparison of its various characteristics shows a closer relationship to *Ichthyodectes* than any other ichthyodectiform genus including *Xiphactinus*, the genus in which it was originally placed. However it is also shown that *Cooyoo* differs sufficiently from both *Xiphactinus* and *Ichthyodectes*, to justify its removal to a separate genus.

The most important features separating *Cooyoo* from both *Xiphactinus* and *Ichthyodectes* are:

- 1) The angle of rise of the supraoccipital crest;
- 2) The shape of the frontals;
- 3) The form of the sphenotic;
- 4) Size, shape and orientation of the hyomandibular;
- 5) Shape of the premaxillary; and
- 6) Size of the maxillary teeth.

The significance of these differences is emphasised when the characters which have been

used to diagnose other ichthyodectiform genera are examined. Characters used include dentition, degree of flexure of the parasphenoid, form of maxillary and dentary bones, form of the palatine head and presence or absence of ornament on the parietals (Bardack 1965). The character differences listed above are thus considered sufficient to support the placement of this species into a new genus.

The material of *Cooyoo australis* examined in this study showed little morphological variation between specimens. This is in contrast to the findings of Patterson and Rosen (1977) who observed significant variation between specimens of *Cladocycilus*. Patterson and Rosen (1977) felt unable to determine whether these differences were sexual, specific or generic '... because of the inadequacy of our sample, and because of absence of comparable information for other ichthyodectiform "genera".' (Patterson and Rosen 1977). The fact that no significant morphological variation was observed among specimens of *Cooyoo australis* suggests that the variations observed by Patterson and Rosen (1977) in *Cladocycilus* are not due to sexual dimorphism but probably represent at least specific differences.

The problems of assessing the significance of morphological variation is compounded in most cases by paucity of material. This is probably the main reason that no attempt has yet been made to rank the importance of morphological differences observed within the ichthyodectiform group. The need for such a study is emphasised by the fact that most ichthyodectiform genera are monotypic. Additionally in the few genera in which more than one species is recognised, the species are based on geological or geographic distribution (Bardack 1965; Patterson and Rosen 1977).

Allowing for the factors mentioned above it is concluded that while it has been shown that *Cooyoo australis* shares more characters with *Ichthyodectes* than *Xiphactinus*, it has also been demonstrated that *Cooyoo australis* possesses sufficient morphological distinctiveness from both these genera to warrant the placement of it into an independent genus.

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LOWER CARBONIFEROUS PALAEONISCIDS (PISCES : ACTINOPTERYGII) FROM QUEENSLAND

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ABSTRACT

Incomplete remains of Lower Carboniferous palaeoniscoid fishes from the Star of Hope Formation, northern Queensland, are described and figured, but due to absence of diagnostic features must be assigned to the suborder Palaeoniscoidei, family indeterminate. Lower Carboniferous palaeoniscoid remains from the Narrien Range, central Queensland, are figured for the first time; such microfossils could provide biostratigraphic information. Queensland records of Carboniferous palaeoniscoid fishes are discussed and compared with those from the Mansfield fauna of Victoria.

INTRODUCTION

Robert Etheridge jnr (in Jack and Etheridge 1892, pp. 136, 296) mentioned a headless palaeoniscoid fish from the Star of Hope Formation which he regarded as a possible new species of the genus *Palaeoniscus*, and named it after the collector W.H. Rands. There is some uncertainty regarding the identification of GSQ L1522 as being the same specimen to which Etheridge referred, as he did not refer to a specimen number. We are confident that the specimen seen by Etheridge and by A.S. Woodward was actually GSQ L1522, in the absence of other articulated remains of palaeoniscoids from the same district. Turner (1982, p. 601) and Long and Turner (1984, p. 242) both refer to the name given by Etheridge to his material as *nomen nudum*, and therefore we refrain from useage of this name in this work to avoid future confusion. In this paper we describe two specimens of palaeoniscoid fishes from the Star of Hope Formation and attempt to summarize the status of other Carboniferous palaeoniscoids from other parts of Australia.

SYSTEMATIC DESCRIPTION

Family ACTINOPTERYGII
Order PALAEONISCIFORMES
Suborder PALAEONISCOIDEI

Palaeoniscoid Family and Genus indet. A.
(Pl. 1A, Fig. 1)

MATERIAL EXAMINED

Specimen GSQ L1522 from the Suttor River, 4 miles WSW of Mt McConnell, near Lornesleigh Station,

Charters Towers district, north Queensland, Lower Carboniferous; Star of Hope Formation ('Star Beds'); impression of part of body only from behind to pectoral region to the posterior of the trunk including most of the caudal fin, excluding the extremities of the dorsal and ventral hypochordal lobes. Squamation intact in places.

DESCRIPTION

The specimen (Pl. 1A, Fig. 1) is a small palaeoniscoid fish having a slender caudal peduncle. There are approximately 15-16 scale rows from the anterior extent of the ventral hypochordal lobe of the caudal fin to the posterior extent of the dorsal fin. There are about 13 scales in the posterior most scale rows and up to 18 at the level of the dorsal fin. On average typical rhomboid body scales are 1.5 mm long by 1.0 mm wide. Nine dorsal fulcral scales are visible from the caudal inversion scale row to the dorsal fin, although we infer that eleven would have been present because of the spacing posterior to the dorsal fin rays. The dorsal fulcral scales are ovoid in shape becoming more triangular posteriorly, merging evenly with the elongate caudal fulcral ridge scales. The first, inferred, dorsal fulcral scale abuts two rows, as do the fifth, sixth and eighth dorsal fulcral scales. The ninth dorsal fulcral scale at the position of the caudal inversion abuts two to three scale rows. There are disrupted ventral fulcral scales seen between the caudal fin and the tenth scale row (from posterior), indicating that the ventral midline of the caudal peduncle bore fulcral scales which were presumably slightly longer than the dorsal fulcral scales. The dorsal fulcral scales have a faint ornament of posteriorly directed ridges whereas the fulcral scales on the

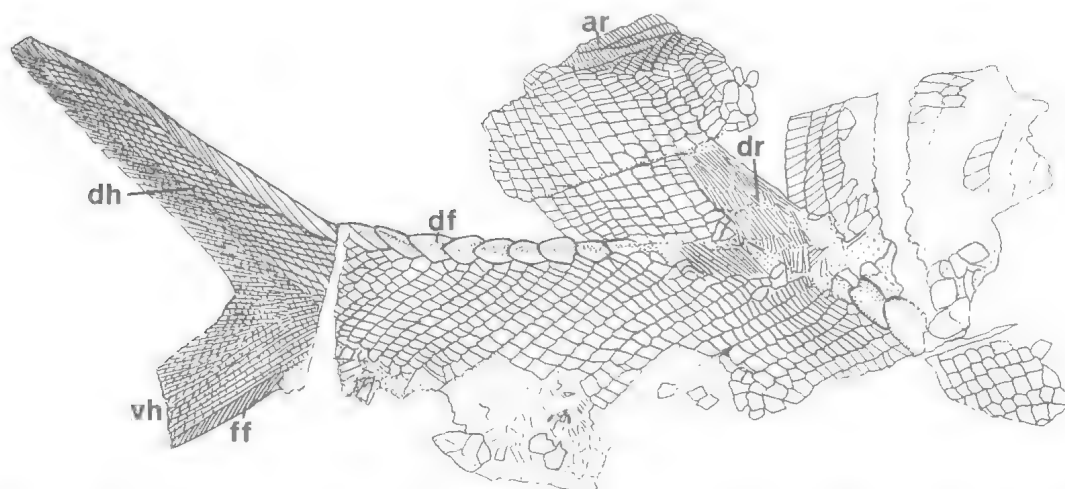


FIG. 1: Sketch — *Palaeoniscoid* gen. et sp. indet. A. GSQ L1522. Abbreviations: ar — anal fin rays; df — dorsal fulcral scales; dh — dorsal hypochordal lobe; dr — dorsal fin rays; ff — fringing fulcral scale; vh — ventral hypochordal lobe. Scale bar — 10 mm.

dorsal hypochordal lobe are smooth. The caudal fin is apparently deeply cleft and has a closely-packed series of fringing fulcral along the leading edge of the ventral hypochordal lobe. *Lepidotrichiae* are segmented and bifurcating.

DISCUSSION

From the above description, with the lack of detailed scale ornament and because the head region is absent, it is clear that the original specimen cannot be accurately placed within the *Palaeoniscoidei*. The discovery of further specimens with good cranial material particularly would help to define the position of this *palaeoniscoid* more accurately if we could relate such specimens to the original.

Palaeoniscoid Family and Genus indet. B. (Pl. IB-C, Fig. 2)

DESCRIPTION

A second articulated specimen, CPC 25610, came from close to the first locality, 2 miles NNW of Mt McConnell Homestead. This specimen is a patch of squamation clearly exhibiting the scale ornament (figured as F22921 in White 1968). About 16 oblique scale rows are preserved. On average the rhombic body scales are 2.5 mm long by 2.0 mm wide. At least four large basal fulcral or ridge scales can be seen towards the corner of one side. The ornament on these body fulcral scales consists of a series of curved ridges following

the curved rhombic outlines of the scale; the ridges anatomose anteriorly and some have small bulbous swellings along their length. In the rounded ridge scales there is a slightly raised anterior zone leading into the middle ridge; the six-seven main lateral ridges on either side curve around this central area and end posteriorly in a series of up to 14 digitations (Fig. 2). The rhombic body scales are ornamented with about 10 ridges which also have swellings along their length in some cases.

DISCUSSION

This second specimen might belong to the same taxon as *Palaeoniscoid* Family and Genus indet. A because of the similar development of scale shape and body (i.e. dorsal and ventral as opposed to caudal) fulcral scale ornamentation and because it comes from a similar stratigraphic horizon. More material will be needed to assess further the status of these specimens.

REMARKS

The genus *Palaeoniscum* s.s., which is known from the Upper Permian to Lower Trias, was reviewed extensively by Aldinger (1937, p. 95), who gave a new diagnosis (see also Gardiner 1963). The generalized features of the caudal region of the genus *Palaeoniscum*, such as a narrow caudal peduncle, deeply cleft tail and fringing fulchra, can be seen on GSQ L1522, although many Permo-Carboniferous *palaeoniscoids* have dorsal and

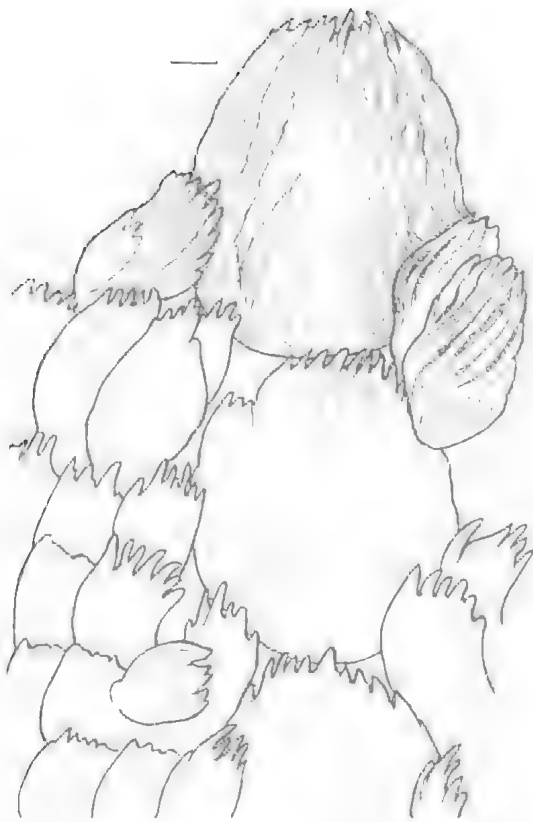


FIG. 2: *Palaeoniscoid* gen. et sp. indet. B. CPC 25610, sketch to show squamation pattern and ornamentation in fulcral region; scale bar approx. = 1mm. Posterior to top.

ventral fulcral scales and fringing fulcra along the leading edges of the fins (Lehmann 1966). Scale morphology has been little studied to date, and is as yet unreliable for identification of palaeoniscoids because of the superficial similarities between the scales of the same region of the body exhibited by most genera (see for example, figures in Traquair 1888–1914). However, comparison with recent studies, those on teleost scales by Grande (1982), for instance, provides hope that a future analysis of scale characters in palaeoniscoids could provide useful phylogenetic and biostratigraphic information. For now, palaeoniscoids can only be reliably identified from cranial material. Kazantseva-Selezneva (1981) lists over 47 families of palaeoniscoids, all of which require details of the cranium for identification.

OTHER AUSTRALIAN RECORDS OF *PALAEONISCUM*

Long and Turner (1984) summarized the records of *Palaeoniscum* from Australia as follows:

1. *P. antipodeus* Egerton 1864: L. Trias, NSW; Aldinger (1937), genus uncertain.
2. *P. feistmantelli* Woodward 1891: L. Trias, NSW; Aldinger (1937), genus uncertain.
3. *P. crassus* (Woodward 1908): L. Trias; Aldinger (1937), genus uncertain.

Long and Turner (1984) assigned all provisionally to the Family Palaeoniscidae.

Conclusion: the occurrence of the genus *Palaeoniscum* in Australia is not proven.

THE MANSFIELD FAUNA

The only other well-known Carboniferous fish fauna in Australia is that studied by Woodward in 1906. He described the Lower Carboniferous fish fauna from the Mansfield Basin, Victoria which included two new palaeoniscoid species, which he named *Elonichthys sweeti* and *Elonichthys gibbus*. These represent the only other Carboniferous palaeoniscoids described from articulated material in Australia.

In a review of that material Long (1984) prepared the specimens and revealed that two new genera were present in the fauna. The genus *Elonichthys*, as defined by Gardiner (1963), is not present in the material. The Mansfield palaeoniscoids are now known to comprise one new genus of gonatodid and a new genus of palaeoniscoid belonging to its own monotypic family. This latter form is somewhat similar to GSQ L1522 but differs in having fewer scale rows from the dorsal fin to the caudal scale row inversion.

SUMMARY OF RECORDS OF CARBONIFEROUS PALAEONISCIDS IN QUEENSLAND

Other palaeoniscoid remains have been found in Queensland throughout the Carboniferous; most are represented by scales alone and, as yet, none has been described in detail. J.T. Woods, then Senior Palaeontologist at the Geological Survey of Queensland, made preliminary attempts at identification of the Survey palaeoniscoid specimens (e.g. Woods 1964). Most of those scales mentioned in the literature have been referred to the genera '*Palaeoniscus*' and '*Elonichthys*' (see Turner 1982). We have stressed above the genus *Palaeoniscus* is not present in Australia. As the identification of the other genus is based on remains which are mostly patches of scales, and

because the Mansfield forms have been discounted, the presence of *Elonichthys* in Australia is also dubious. Many of the scales are similar to those shown in Plates 1 and 2 and some probably belong to *elonichthyids*.

Scales in the Sybil Group, Marshs Creek Beds of north Queensland, however, are not the typical peg and socket-bearing rhomboid scales; these are cycloid scales which Woods thought comparable with those of *Cryphiolepis*, for the Survey specimens are so designated. These scales are similar to ones recently described from the Early Permian of Western Australia by Archbold (1981), which Turner (in press) has referred to the Family *Cryphiolepidae*.

The following examples bearing palaeoniscoid scales have been found in the collections of the Queensland Museum (QM), the Geological Survey of Queensland (GSQ), the Bureau of Mineral Resources, Canberra (CPC, BMR) and the University of Queensland Geology Department (UQ), and during field work by the senior author (RF).

LOWER CARBONIFEROUS

DRUMMOND BASIN

For geology see Olgers 1972, and Day *et al.* 1983.

TELEMON FORMATION (Tournaisian)

1. QM L52, L56 and L71, bone bed and dark grey limestone from the centre of the Narrien Range, south of Anne Peak, west of Clermont (Bartholomai in de Bretzel 1966, Turner 1982) — examples shown in Plate 2.
2. GSQ 170, 173 and 174, limestones collected 'west of Clermont' by K. Gough 1961.

RAYMOND FORMATION

1. QM RF 1-3, bone bed in algal limestone about 100 m from base of formation, eastern flank of the Narrien Range, west of Clermont.
2. QM M99, bone bed in blue limestone about 233 m above base of formation, north of Anne Peak and Star of Hope Bore Road (Bartholomai in de Bretzel 1966, Turner 1982).

DUCABROOK FORMATION

1. QM (archival letters from Mr Sexton, 1883); GSQ 1523, 1524, L292, L553 (Jack and Etheridge 1892); UQ F1932-34, UQ F9948, UQ F17347-51, Bogantungan-Hannam's Gap railway cutting, including Medway Creek near

Railway Bridge, or creeks within 2 km.

2. UQ F29778-93, limestone M561, Withersfield Railway Station (Shell 1952).
3. UQ F24403-4, UQ F58309, algal (M318) and oolitic (M349) limestones, Callistemon-Echo Hills section (Shell 1952).
4. UQ F24400, limestone M778, Anakie uplift section c-c1 (Shell 1952).
5. UQ F58311, sandy oolitic limestone M800a, Cattle Creek.
6. UQ M238 silty limestone with *Leaia*, west flank Nogoia anticline.
7. GSQ F8617 Ducabrook Homestead, SE of Emerald (pl. C XIV, figs. 14-15, Hill and Woods 1964).

NORTH QUEENSLAND

STAR OF HOPE FORMATION

1. GSQ L1522, Suttor River, WSW of Mt McConnell, Lornesleigh Station.
2. CPC F22921, NNW Mt McConnell Station.
3. BMR localities 280 — limestone with palaeoniscoid scales, and 126/2 — siltstone with bone and scales.

UPPER CARBONIFEROUS

NORTH QUEENSLAND BURDEKIN-STAR BASIN

SYBIL GROUP, MARSHS CREEK BEDS (see Day *et al.* 1983, figure 6).

1. GSQ L293, L398, limestones near New Moon Station.

SOUTHEAST QUEENSLAND

1. GSQ Vince Palmieri coll. no. 1 33, Lower Pennsylvanian Barambah limestone, 'Wondai Series'?, SE of Murgon (Palmieri 1969).

CONCLUSIONS

Carboniferous palaeoniscoid material in Australia (except for the Mansfield fauna, Long, in press) is not well-defined below the familial

PLATE 1: Articulated palaeoniscoid specimens from the Lower Carboniferous of Queensland. A. GSQ L1522, Palaeoniscoid gen. et sp. indet. A from Suttor River, near Mt McConnell, $\times 1$. B. CPC 25610 Palaeoniscoid gen. et sp. indet. B. Cast of palaeoniscoid scales from Mt McConnell Station, $\times 1$. C. Close up of cast of basal fulcral scales of CPC 25610 to show scale ornament, $\times 4$.



level. The specimen from north Queensland referred to '*Palaeoniscus*' by Etheridge jnr is an indeterminate palaeoniscoid.

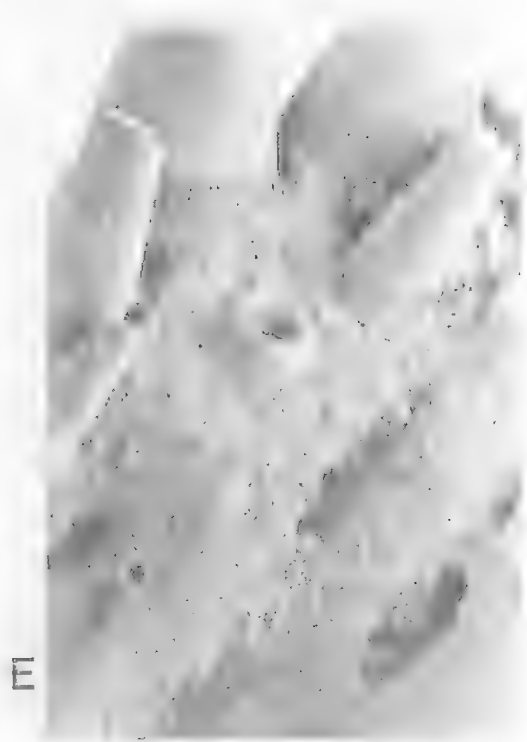
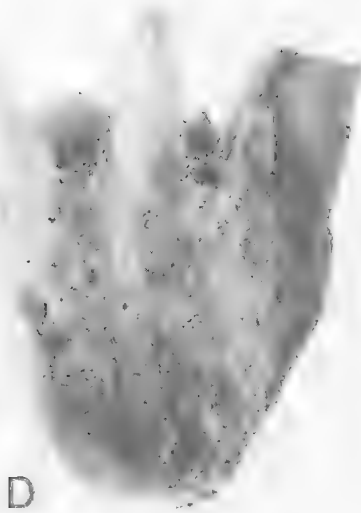
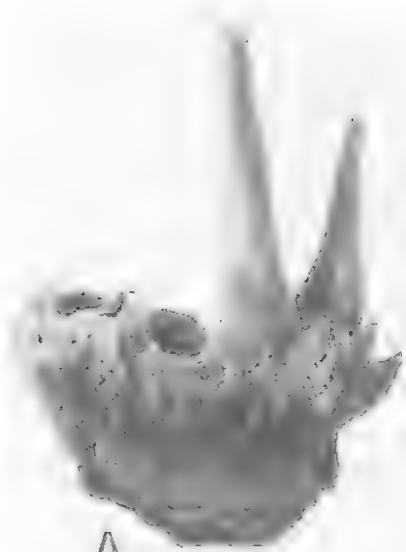
Work has begun on the Carboniferous vertebrate microfauna from several localities in Queensland. It is hoped that specific differences between scales, especially fulcral scales, tooth plates, and teeth, for instance, will allow some biostratigraphic use of the palaeoniscoids to be made in the future. Plate 2 shows some examples of Lower Carboniferous palaeoniscoid microremains from the Telemon Formation of the Narrien Range. On the basis of scale and dermal bone ornamentation of this material at least three types of palaeoniscoid appear to be present in the Lower Carboniferous of Queensland. Braincase material preserved in the Narrien samples indicates that the palaeoniscoids appear to be primitive.

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- PLATE 2: Palaeoniscoid microremains from locality L52, Telemon Formation, Narrien Range, central Queensland. A. QM F13402. Labial view of toothplate of palaeoniscoid gen. et sp. indet. C, approx. $\times 60$. B. QM F13403. Lingual view of toothplate of palaeoniscoid gen. et sp. indet. D, approx. $\times 35$. C. QM F13404. Dorsal view of ventral (?) fulcral scale of palaeoniscoid gen. et sp. indet., approx. $\times 38$. D. QM F13405. Labial view of toothplate of palaeoniscoid gen. et sp. indet. E, approx. $\times 60$. E. QM F13403. Close up of teeth in labial view to show fine structure and tooth attachment, approx. $\times 100$.



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FIRST JURASSIC ACTINOPTERYGIAN FISH FROM QUEENSLAND

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ABSTRACT

Seven fragmentary specimens of ray-finned, possibly neopterygian, fish, which represent the first fish of this period in the State, are described from two localities in the Middle Jurassic Walloon Coal Measures of Balgowan Colliery, southeast Queensland. Six of the fish specimens from Balgowan Tunnel are preserved mainly as carbonaceous impressions in fine grained grey lithic sandstone. Remnants of the original scales, scale tissue and a presumed dorsal fin are present in the other specimen which comes from the Rosalie Workings, Balgowan. The significance of the record is assessed by comparison with other Australian Jurassic fish from New South Wales.

INTRODUCTION

The Jurassic coal measures of the Ipswich coalfield have been investigated thoroughly since around the turn of the century (Gould 1968). In 1951 Jack Tunstall Woods, then geological assistant at the Queensland Museum, collected six specimens from the coal measures of Balgowan Tunnel, Balgowan Colliery, 19 km (12 miles) north of Oakey, which he thought might be fish remains; these were the first possible fish remains of this age to be found in the State. When reviewing the Queensland fossil fishes, Turner (1982) did not include these specimens because they were thought at that time to be plant material. During a subsequent search in the collections of the Geological Survey of Queensland the junior author came across a fish specimen from the Walloon Coal Measures which closely resembles the material in the Queensland Museum. This specimen was collected by Mr Godfrey, the Colliery Manager, in March 1952. The seven specimens are described here for the first time and figured in Plate 1.

AGE OF FISH-BEARING BEDS

Mengel (1963) reviewed the geology and coal resources of Balgowan Colliery. However, little has been published on the flora and fauna of the coal measures exposed in these particular mines. With the exception of numerous, mainly theropod, dinosaur tracks found in roof shales (for review of literature see Gould 1974 and Molnar 1982), there are no other records of fossil vertebrates from Balgowan Colliery; to our knowledge no other macro- or microfossils, plant or invertebrate, are recorded from this site.

The coal measure succession at Balgowan Colliery is part of the Walloon Coal Measures (Day *et al.* 1983) which has a widespread surface and subsurface distribution in Queensland (Gould 1968, Cranfield *et al.* 1976). Based on palynological evidence, the age of this formation is now considered to be Middle Jurassic (U. Bajocian – L. Callovian) (de Jersey and Paten 1964). The Walloon Coal Measures megaf flora of Queensland was reviewed by Gould (1974, 1981). It contains bryophytes, arthropytes, pteridophytes and gymnosperms, of which conifers are dominant; more detailed research on most taxa is needed.

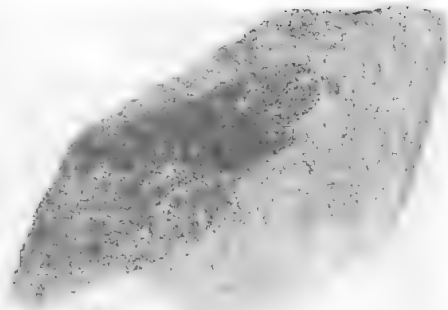
DESCRIPTION OF MATERIAL

The specimens (Plate 1) are all partial body sections covered with scales and described below. Specimens QM F13632–6 were all found in association but it seems unlikely that they all originally belonged to one fish.

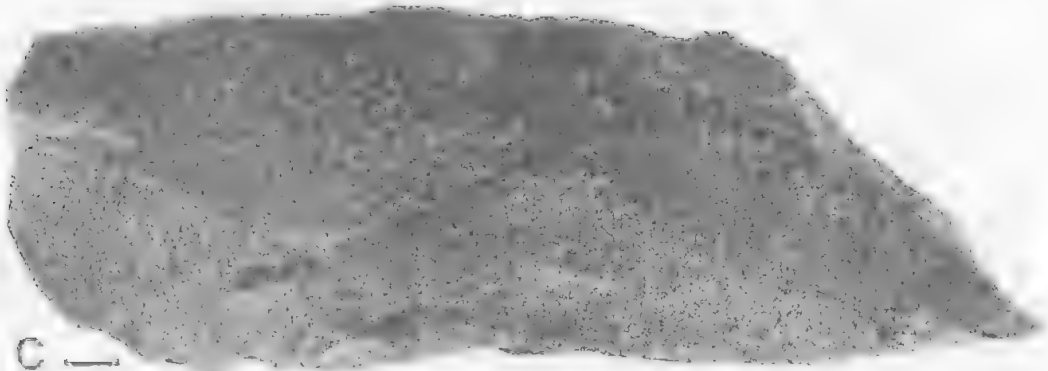
Specimen GSQ F12975 (Plate 1A) is the only specimen with a natural outline preserved; the head region and caudal fin are missing. Imbrication of the scales on the right side of GSQ F12975 indicates the anterior end of the fish which is broken off behind the operculum. This specimen has a distinct convex dorsal margin and two-thirds of the way along this surface from the front there is a small dorsal fin making an angle of about 20° with the flank. This fin originates at about the level of oblique scale row 27 of the 39–40 preserved oblique scale rows. The scales are rhombic, the largest in the mid-flank region having a maximum (oblique dorso-ventral) length of 5 mm and a width of about 2.5–3 mm; smaller scales occur to front



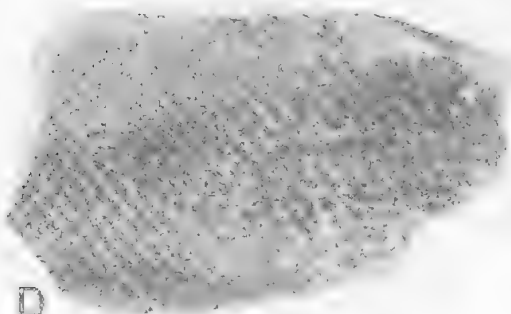
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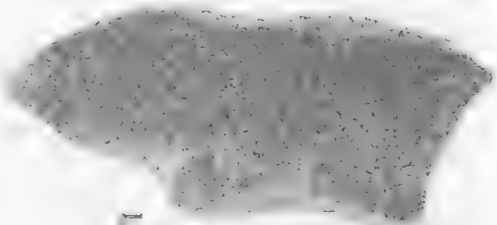
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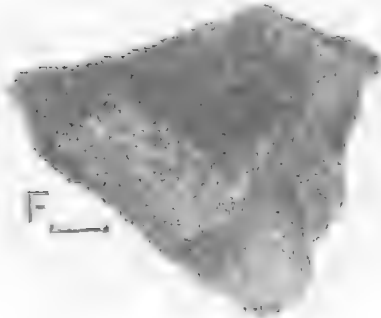
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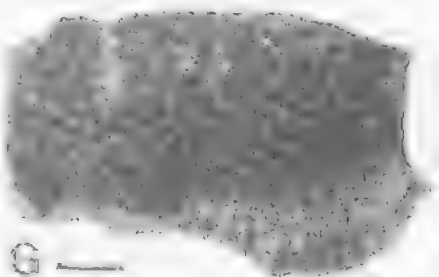
D —



E —



F —



G —

and rear. Behind the anterior edge of the dorsal fin there is a distinct caudal inversion of scales. The squamation presents a simple pavement of these rhombic scales, which appear to have only a thin covering of shiny semi-opaque tissue; this tissue is preserved over the surface of the scales of much of this specimen unlike those from Balgowan Tunnel. There is no scale ornament. The scales in the oblique rows are offset about midway along their length. The posterior border of the imbricated scales is straight and no sign of peg and socket articulation can be seen. Only the lower portions of six rays are exposed in the dorsal fin and no segmentation is visible. There appears to be at least one large fulcral scale preceding the dorsal fin. Further modified scales are not obvious but at least two are present in the base of the fin. Eight fringing fulcra are preserved. About six horizontal scale rows down from the dorsal surface there is an intermittent raised ridge in the squamation which may be the lateral line, or possibly an artefact of fossilization; no lateral line scales can be distinguished.

Specimen QM F13632 (Plate 1C) also has large rhombic scales arranged in about 38 oblique rows. The scales, however, are not so offset in this specimen. No original tissue is preserved and the scales appear as dark brown carbonized stains, or sandstone rhombs with carbonized outlines. Pieces of plant stem and comminuted plant debris surround the squamation.

Specimen QM F13633 (Plate 1F) is a small patch of squamation made up to about ten incomplete scale rows. Specimens QM F13634a and b (Plate 1E and G), QM F13635 and QM F13636 (Plate 1B and D) are also fragmentary, made up of about 19–20, 15, 5 and 33 oblique scale rows respectively. Specimen QM F13636 exhibits the maximum depth of squamation (Table 1).

The fish specimens are all thought to be actinopterygians because of the presence of rhombic scales and the rayed fin. The fishes, which bear relatively thin scales which may or may not be formed of a surface layer of dentine or

enameloid, probably belong to one of the lower actinopterygian groups. The general form of the Queensland specimens is similar to the neopterygian halecostome, *Huilettia*, from the Middle Jurassic (Bathonian) of the western USA, recently described by Schaeffer and Patterson (1984). However the preservation of the Queensland specimens is relatively poor, and the general resemblance of the squamation and dorsal fin to that of *Huilettia* is almost certainly no more than a superficial convergence or similarity of primitive characteristics.

COMPARISON WITH THE TALBRAGAR FAUNA

The only other verified Jurassic fish fauna in Australia is that from the Talbragar Fish Beds of New South Wales, where a small fauna was discovered in the last century in association with a suite of plant remains (e.g. White 1981a, b). David and Pittman (1895) regarded the Talbragar Beds as equivalent to what they called the Ipswich Coal Measure Series of Queensland (which now excludes the Walloon Coal Measures). Woodward (1895) in his initial assessment of the fish fauna estimated that the fish were of Jurassic age in affinity, 'not earlier than Lias'. The current assessment of the age of these beds is rather broad, being either Middle (Woodward 1895; White 1981a; Schaeffer and Patterson 1984) or Upper Jurassic (White 1981b; Long and Turner 1984).

The fauna is accepted as non-marine because only fish, plants and one insect have been found in the series of fine-grained silicified shales. White (1981b) described the environment at Talbragar as a lush kauri pine (*Agathis*) forest in montane dry rain-forest country surrounding a reasonable-sized lake.

The fish fauna includes a coelacanth, palaeonisciforms, semionotiforms, pholidophoridiforms and possible leptolepidids, although the assignment of some of these species is tenuous or doubtful (e.g. Nybelin 1974, p. 170). The faunal list is as follows (from Hills 1958 and Schaeffer and Patterson 1984):

PLATE 1: Jurassic actinopterygian fish. A. GSQ F12975 Squamation of flank scales and part of dorsal fin. B. QM F13635 Small patch of flank scales. C. QM F13632 Large area of flank scales. D. QM F13636 Small patch of flank scales. E. QM F13634a Small patch of flank scales. F. QM F13633 Small patch of flank scales. G. QM F13634b Small patch of flank scales. Scale bars = 10 mm.

TABLE 1: Measurements of specimens in mm.

Registration No.	Maximum length	Maximum depth
GSQ F12975	115	56
QM F13632	173	45
QM F13636	113	19

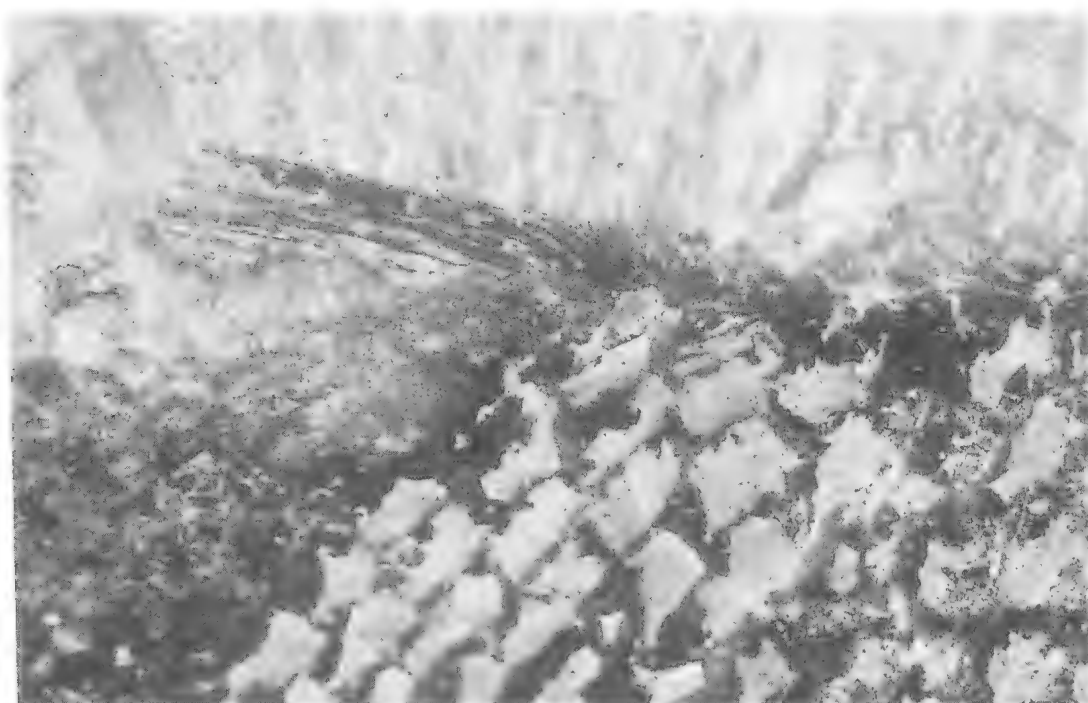
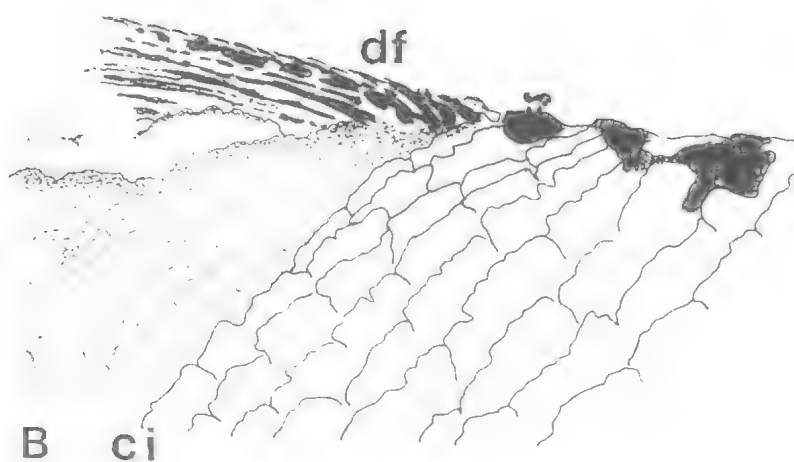
**A****B ci**

PLATE 2: Jurassic actinopterygian fish. Detail of GSQ F12975. **A.** Close up of flank scales and presumed dorsal fin, photomicrograph $\times 4$. **B.** Diagram of the same area to illustrate the dorsal fin (df) and the caudal inversion (ci), approximately $\times 3.3$. Anterior to right in both cases.

coelacanth index.

Coccolepis australis Woodward 1895

Uobryichthys latus Wade 1942

Aethenolepis mirabilis Woodward 1895

Aphenelepis australis Woodward 1895

Archaeomaene tenuis Woodward 1895

Madariscus robustus (Woodward 1895)

'Leptolepis' talbragurensis Woodward 1895

Of these forms only one shows a resemblance to the new Queensland material in the form of its scales. This is the semionotid *Aphenelepis* which has rhombic scales. They are not identical however, to those of the new fish, as they bear slightly radiating 'coarse crimping' (Woodward 1895). All the other forms at Talbragar have cycloid scales. The general form of *Aphenelepis* also differs in that it is relatively short-bodied with only about 17 oblique scale rows to the origin of the dorsal fin. However, Woodward did note the abrupt change in scale size posterior to the dorsal fin origin, a feature also seen in the GSQ specimen.

THE ENVIRONMENT

The flora of the Walloon Coal Measures is similar to that in the Talbragar Fish Beds. It includes lycopods, horsetails, ferns, pteridosperms, benettitaleans, numerous conifers, cycads, and pentoxylales (Gould 1974, 1981; White 1981). The Queensland fish, like the Talbragar fauna, were probably also living in a lake, but one possibly more low-lying than that at Talbragar being associated with nearby peat-forming swamps. Gould (1981) thought that the peat, which eventually became coalified, was autochthonous. The presence of podocarp and araucarian conifers forming the dominant plant group in the Walloon Coal Measures flora, indicates a distinctive southern hemisphere (Gondwanan) plant assemblage suggesting a moist temperate climate (Gould 1981). Gould (1968) also mentioned that the clay component of the shales in the Walloon Formation was koalinite, montmorillonite and bentonite; the latter would indicate possible nearby volcanic activity (e.g. Howell 1962). The ejection of large volumes of volcanic ash into the water bodies would certainly have detrimentally affected the fish population.

CONCLUDING REMARKS

Schaeffer and Patterson (1984) in their recent review of Jurassic fishes summarized all the available information on Jurassic marine and non-marine fish assemblages (see their tables 3 and 4 and Fig. 39). They also stressed that it would be

desirable to search outside Europe, where the faunas are comparatively well-known, for new insights into the phylogeny and palaeobiogeography of Jurassic fishes. Although the new occurrence of Jurassic fish in Australia does not afford much fresh information towards our understanding of the relationships of Australian Jurassic fish to those elsewhere it does pinpoint another example of a non-marine assemblage. It will be well worthwhile investigating further the Jurassic coal measure sequences in Queensland for better material which might fulfill Schaeffer and Patterson's criteria.

ACKNOWLEDGEMENTS

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THE PLIOCENE AND QUATERNARY FLAMINGOES OF AUSTRALIA

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ABSTRACT

From the Quaternary deposits of northeastern South Australia, material of what appears to be four species of flamingo has been recovered. These in order of size are referred to: *Xenorhynchopsis tibialis* de Vis, 1905, larger than extant species of flamingo; *Phoenicopterus ruber* Linnaeus, 1758, similar in size to modern *P. ruber*; *Xenorhynchopsis minor* de Vis, 1905, similar in size to *Phoeniconaias minor* (Linnaeus, 1758); and *Ocyplanus proeses* de Vis, 1905 including *Ibis (?) conditus* de Vis, 1905 and *Phoeniconaias gracilis* Miller, 1963, smaller than extant species of flamingo.

De Vis was unaware that some of the bones he named were those of flamingoes and assigned them as follows: *Xenorhynchopsis tibialis* and *X. minor* to the Ciconiidae, storks; *Ocyplanus proeses* to the Charadrii, waders; and *Ibis (?) conditus* to the Threskiornithidae, ibises. Miller was unaware that de Vis had named and incorrectly assigned some flamingo material. *Ocyplanus proeses* was reassigned by Lambrecht to the Laridae, gulls, and by Condon to the Rallidae, rails, both identifications which are also incorrect.

The material consists of bone fragments, most of which are not diagnostic at the generic level. Furthermore, the size of our samples of modern flamingoes is limited, and even though we have examined each species, a realistic grasp of variability within some species has not been reached in this study. We have, therefore, provisionally retained the generic and specific names that have priority as a convenience until more complete material allows a better evaluation of the systematic positions of the Pliocene and Quaternary flamingoes of Australia.

INTRODUCTION

Flamingoes are not part of the modern avifauna of Australia, and it was not until Miller (1963) described a series of bones from the late Cenozoic deposits of northeastern South Australia that their long history on this continent was recognised. Extinction of flamingoes in Australia has been a relatively recent event, probably occurring during the Late Pleistocene or even Holocene and appears tied to the disappearance of the relatively permanent shallow lakes, which characterized central Australia during much of the Cenozoic. According to Bowler (1982) loss of these lakes occurred in the last 400,000 years.

Since Miller (1963) demonstrated the presence of fossil flamingoes in Australia, further material has been found both in the field and in museum drawers, including some fossil *Phoenicopteridae*, that were collected by Gregory (1906) and described by de Vis (1905) as fossil species of stork, Ciconiidae, of ibis, Threskiornithidae, and of wader, Charadrii. Miller (1963) did not mention the fossil material of flamingoes that de Vis

referred to other taxa, and was presumably unaware of de Vis' error. In fairness to de Vis and Miller, it should be realized that de Vis' reference collection did not contain any bones of flamingoes, so he assigned the unknown bones to the bird groups with the morphologies closest to what he had. Miller probably never examined the fossil flamingo material in the Queensland



FIG. 1. Map of area where late Pliocene and Quaternary fossils of flamingoes were found in northeastern South Australia.

TABLE 1. Elements and distributions of Quaternary flamingoes in northeastern South Australia.

Location	<i>X. tibialis</i>	<i>P. ruber</i>	<i>X. minor</i>	<i>O. proeses</i>	Phoenicopteridae
Kalakoopah Creek (Quaternary) Manku					stn UCMP 128455
Lake Kanunka (Pliocene) Site 1, V-5772		tib UCMP 60562 tmt UCMP 60583	hum UCMP 56882	tib UCMP 56887 tmt SAM P13650 UCMP 60561	
Lower Cooper Creek (Quaternary) Site 4, V-5380 Site 8, V-5860 Site 14, V-5866 (age uncertain) Lower Cooper Unduwampa Wurdulumankula	hum UCMP 56324 tib QM F5515/6	 tmt QM F5518	tib UCMP 94688 hum UCMP 56360 tib QM F5517	 fem QM F5519	
Unknown sites (age uncertain)		fem QM F7013		tmt QM F5512	stn UCMP 69588

TABLE 2. Names, old and new, of specimens of Australian Quaternary flamingoes we have examined.

Specimen number	Element		New name this paper
QM F5512 F5515 F5516 F5517 F5518 F5519 F7013	tmt tib tib tib tmt fem fem	Old name from De Vis (1905)	same same lt same rf same <i>Phoenicopterus ruber</i> rf <i>Ocyplanus proeses</i> rf <i>Phoenicopterus ruber</i> rf
		<i>Ocyplanus proeses</i> ht	
		<i>Xenorhynchopsis tibialis</i> st	
		<i>Xenorhynchopsis tibialis</i> st	
		<i>Xenorhynchopsis minor</i> ht	
		<i>Xenorhynchopsis minor</i> rf	
		<i>Ibis conditus</i> ht	
SAM P13650 UCMP 56324 56360 56882 56887 60561 60562 60583 69588 94688 128455	tmt hum hum hum tib tmt tib tmt stn tib stn	Old name from Miller (1963)	<i>Ocyplanus proeses</i> rf <i>Xenorhynchopsis tibialis</i> rf <i>Xenorhynchopsis minor</i> rf <i>Xenorhynchopsis minor</i> rf <i>Ocyplanus proeses</i> rf <i>Ocyplanus proeses</i> rf <i>Phoenicopterus ruber</i> rf same Phoenicopteridae, indeterminate <i>Xenorhynchopsis minor</i> rf Phoenicopteridae, indeterminate
		<i>Phoeniconaias gracilis</i> ht	
		<i>Phoenicopterus ruber</i> rf	
		<i>Phoeniconaias gracilis</i> rf	
		<i>Phoeniconaias gracilis</i> rf	
		<i>Phoeniconaias gracilis</i> rf	
		<i>Phoenicopterus ruber</i> rf	

Museum collections. Because of this unavoidable oversight, some changes in nomenclature are now necessary.

This paper reviews the Quaternary and Pliocene material of flamingoes (Tables 1 and 2), including that described by de Vis (1905) and Miller (1963) from northeastern South Australia (see Fig. 1). In other papers we will review the earlier Tertiary material of flamingoes, which has a somewhat wider distribution in inland Australia.

ABBREVIATIONS

The following abbreviations have been used in this paper: AM, Australian Museum, Sydney; ANWC, Australian National Wildlife Collection, Division of Wildlife and Rangelands Research, CSIRO, Canberra; NMV, Museum of Victoria, Melbourne; QM, Queensland Museum, Brisbane; SAM, South Australian Museum, Adelaide; SAIM, South African Museum, Cape Town; UCMP, University of California, Museum of Paleontology, Berkeley; UCMVZ, University of California, Museum of Vertebrate Zoology, Berkeley; @ = approximately; fem = femur; hum = humerus; tib = tibiotarsus; tmt = tarsometatarsus; stn = sternum; ht = holotype; lt = lectotype; st = syntype; rf = referred.

COMPARATIVE MATERIAL

The main comparative material utilized in this study has been the extensive avian osteological collections in the Australian Museum, the Australian National Wildlife Collection, and the Museum of Victoria, which include representatives of almost all extant non-passeriform families and of the extinct Australian, American, and European Palaeodidae. Also available for comparison were all of the Tertiary flamingoes from Australia that were reported on by Miller (1963) and what has been found since, as well as casts of *Elornis anglicus* and *Leakeyornis aethiopicus*. The remaining comparisons were made with descriptions of all known fossil flamingoes.

The following modern flamingo material was available:

Phoenicopterus ruber: AM S424, S592, S594, S599, S600, S603, and O.56875; NMV B737, B738 and B748. SAM B5097 ♂, B11462, B11548 and B11552. The tarsometatarsi of these specimens, except for NMV B738, are all longer than 30 cm and, therefore, of males according to the tarsal measurements given in Brown *et al.* (1982), Blake (1977) and Cramp (1977).

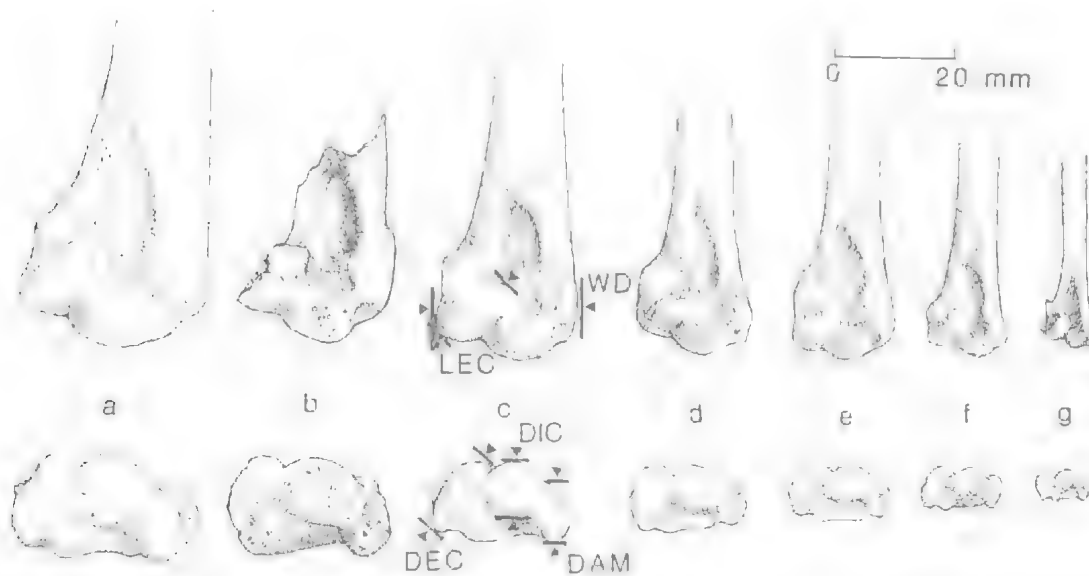


FIG. 2. Palmar and distal views of distal end of right humeri of: Black-necked Stork, *Xenorhynchus asiaticus*, AM B4139 (a); rf *Xenorhynchopsis tithialis*, UCMP 56324 (b); Greater Flamingo, *Phoenicopterus ruber*, AM S599 (c); Straw-necked Ibis, *Threskiornis spinicollis*, ANWC BS2986 (d); Lesser Flamingo, *Phoeniconaias minor*, ANWC BS2985 (e); Bush Stone-Curlew, *Burhinus magnirostris*, ANWC BS1855 (f); Banded Stilt, *Cladorhynchus leucocephalus*, SAM B31542 (g). Measurements for Tables 3, 4 and 11 are indicated as follows: WD = width of distal end, LEC = length of external condyle, DEC = depth of external condyle, DIC = depth of internal condyle and DAM = depth of attachment of *M. pronator brevis*.

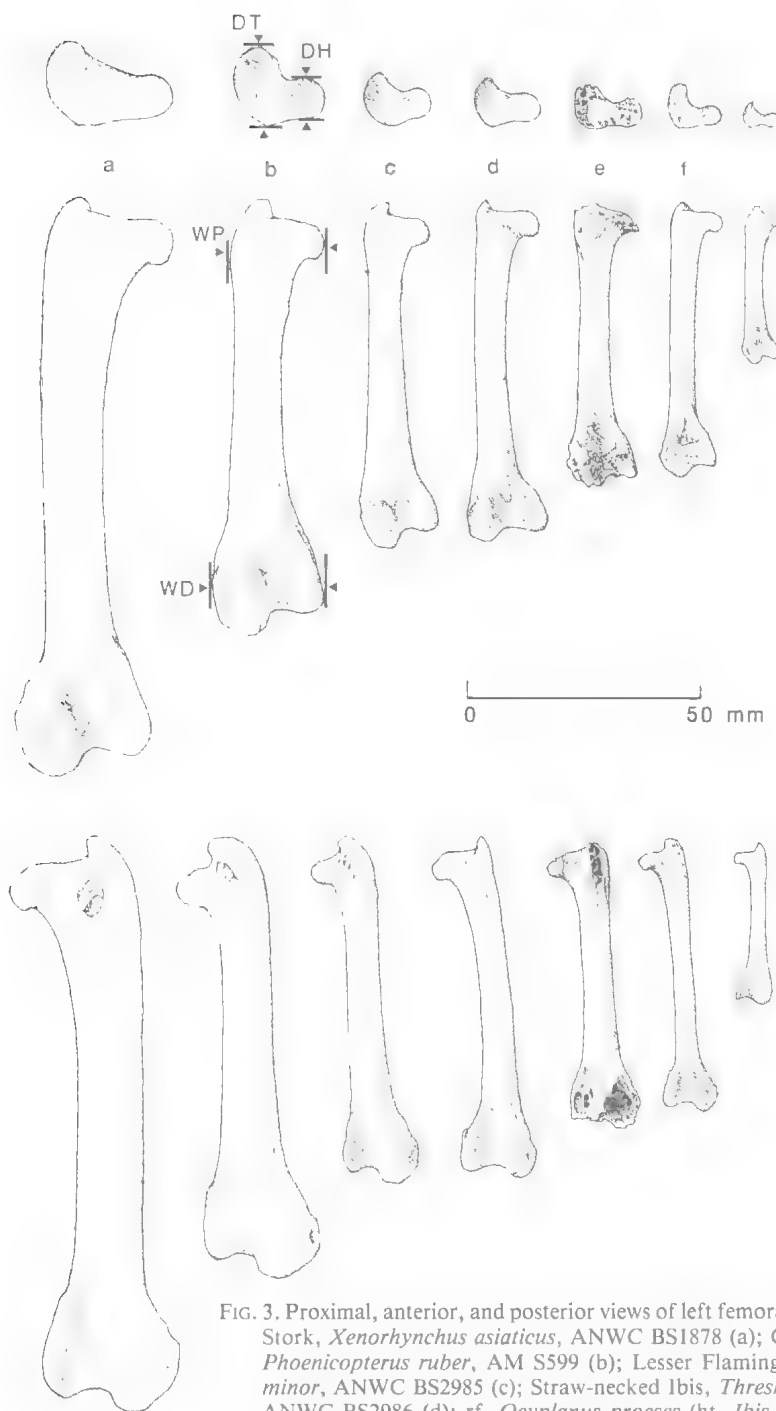


FIG. 3. Proximal, anterior, and posterior views of left femora of: Black-necked Stork, *Xenorhynchus asiaticus*, ANWC BS1878 (a); Greater Flamingo, *Phoenicopterus ruber*, AM S599 (b); Lesser Flamingo, *Phoeniconaias minor*, ANWC BS2985 (c); Straw-necked Ibis, *Threskiornis spinicollis*, ANWC BS2986 (d); rf. *Ocyplanus proeses* (ht. *Ibis* (?) *conditus*, QM F5519 (e); Bush Stone-Curlew, *Burhinus magnirostris*, ANWC BS1855 (f); Banded Stilt, *Cladorhynchus leucocephalus*, SAM B31542 (g). Measurements for Tables 5, 6 and 11 are indicated as follows: WP = width of proximal end, WD = width of distal end, DT = depth of trochanter and DH = depth of head.

Phoenicopterus ruber chilensis: AM S549; NMV B12740; SAM B25448 ♂; UCMVZ 125157 ♂, 12158 ♀, and 140923 ♂.

Phoeniconaias minor: ANWC BS2985 ♀; SAM Zo57025 ♂; UCMVZ 133408 ♀, 133409 ♀, 133410 ♀ and 133411 ♂.

Phoenicoparrus andinus: UCMVZ 126566 ♀, 126567 ♂ and 129326 ♂.

Phoenicoparrus jamesi: UCMVZ 154304 ♂.

DIAGNOSIS OF ELEMENTS OF PHOENICOPTERIDAE REPRESENTED BY AUSTRALIAN PLEISTOCENE MATERIAL

The skeletal elements of Australian Pleistocene flamingoes that are available can be diagnosed from those of other avian families as follows:

STERNUM. Anterior end. In anterior view, ventral manubrial spine robust and triangular in shape with apex pointing ventrally; line dividing left from right coracoidal sulcus not perpendicular, but courses diagonally between sulci terminating on right side of base of ventral manubrial spine; coracoidal sulci with robust, but low and rounded dorsal lips; in ventral view, carina does not originate from base of manubrial spine.

HUMERUS. Distal end (Fig. 2). In palmar view, entepicondylar prominence low and gently rounded, not protruding far internally; where preserved, ectepicondylar prominence low, not protruding as a process; brachial depression elongate and deep; attachment for anterior articular ligament narrow and elongate, with long axis parallel to long axis of shaft; ectepicondyle subdued, not extending laterally beyond external condyle; in medial view, distal end of bone shallow, not inflated.

FEMUR. (Fig. 3) Proximal end. In proximal view, head large, with depth being somewhat greater than one-half that of trochanter; anterior border of proximal end deeply concave, and highly curved, not straight; posterior border does not protrude far posteriorly; head does not protrude far internally beyond shaft, thus having very short neck; trochanter arises abruptly from nearby flat proximal articular surface, and forms tall crest that is concave internally.

Distal end. In posterior view, popliteal area broad, shallow, almost flat and marked with prominent ligamental scar in the middle; medial margin of popliteal area very straight, elongate ridge that merges with posterior intermuscular line

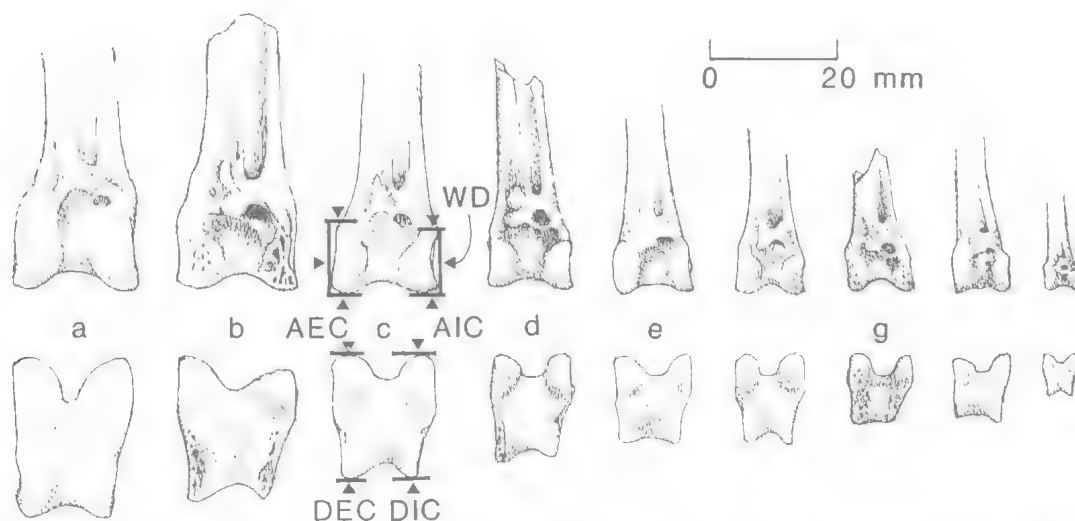


FIG. 4. Anterior and distal views of distal end of right tibiotarsi of: Black-necked Stork, *Xenorhynchus asiaticus*, ANWC BS1878 (a); lt. *Xenorhynchopsis tibialis* QM F5515 (b); Greater Flamingo, *Phoenicopterus ruber*, AM S599 (c); ht. *Xenorhynchopsis minor*, QM F5517 (d); Straw-necked Ibis, *Threskiornis spinicollis*, ANWC BS2986 (e); Lesser Flamingo, *Phoeniconaias minor*, ANWC BS2985 (f); rf. *Ocyplanus proeses*, UCMP 56887 (g); Bush Stone-Curlew, *Burhinus magnirostris*, ANWC BS1855 (h); Banded Stilt, *Cladorhynchus leucocephalus*, SAM B31542 (i). Measurements for Tables 7, 8, 11 and 12 and Figure 6 are indicated as follows: WD = width of distal end, DIC = depth of internal condyle, DEC = depth of external condyle, AIC = anterior length of internal condyle and AEC = anterior length of external condyle.

proximally and which lacks any protuberances along it; internal condyle anteroposteriorly compressed, with internal surface of shaft flattened and smooth.

TIBIOTARSUS. Distal end (Fig. 4). In anterior view, distal end mediolaterally compressed, and condyles not elongate proximodistally; tendinal groove offset toward medial side of bone, not centred on shaft; tendinal bridge not 'broad' proximodistally; marked ligamental protuberance present on laterodistal end of supratendinal bridge that merges with short ridge, which itself lies well internal to lateral border of shaft; condylar fossa deeply excavated, even undercutting bases of condyles; internal condyle in most cases extends only slightly distal to external condyle; in distal view, condyles deep and width across them decidedly greater anteriorly than posteriorly; posterior articular surface distinct from anterior; condyles not of subequal depth.

TARSOMETATARSUS. Distal end (Fig. 5). Trochlea IV extends decidedly farther distally than II, and III extends farthest; in medial view, distal end of trochlea II flattened or only slightly curved,

not highly convex; in distal view, trochleae highly arched, resulting from trochlea II being twisted posteriorly and externally from the front of the tarsometatarsus; trochlea III narrow and deep, not shallow and broad; anterior border of trochlea II broader than posterior border.

SYSTEMATIC POSITIONS OF AUSTRALIAN PLIOCENE AND QUATERNARY MATERIAL

The fossil material of *Phoenicopteridae* from the Pliocene and Quaternary of Australia which we have examined includes that reported on by de Vis (1905) and Miller (1963) and is summarised in Tables I and 2. As suggested in Rich and van Tets (1982), this material appears to include four size categories (Tables 3-10, Figs 6 & 7): larger than the Greater Flamingo, *Phoenicopterus ruber*; similar in size in *P. ruber*; similar in size to the Lesser Flamingo, *Phoeniconaias minor*; and smaller than *P. minor*.

The fossil material is still too rare and fragmentary for us to decide whether these forms

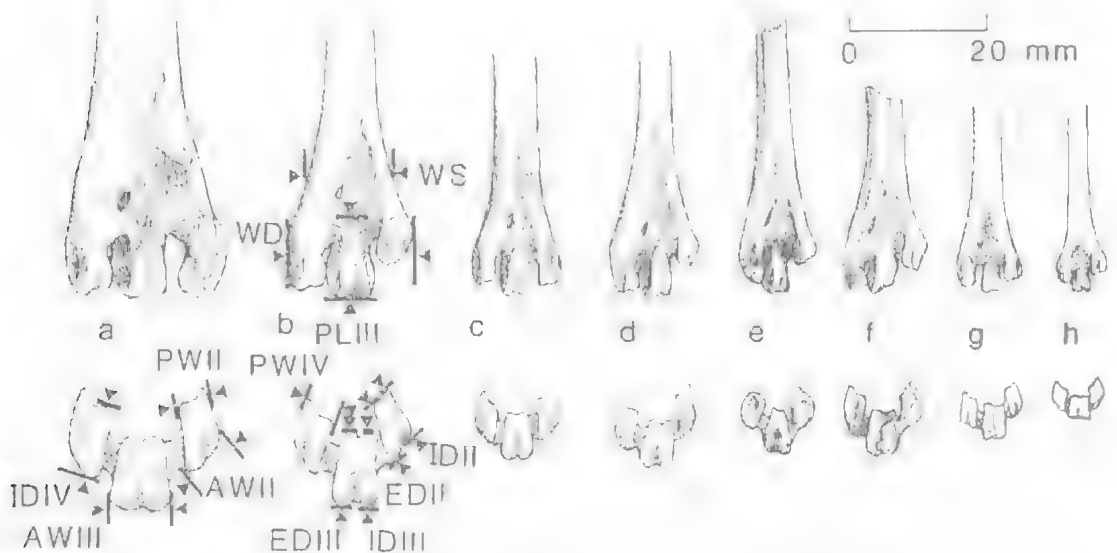


FIG. 5. Posterior and distal views of distal end of left tarsometatarsi of: Black-necked Stork, *Xenorhynchus asiaticus* ANWC BS1878 (a); Greater Flamingo, *Phoenicopterus ruber* AM S599 (b); Straw-necked Ibis, *Threskiornis spinicollis*, ANWC BS2986 (c); Lesser Flamingo, *Phoeniconaias minor* ANWC BS2985 (d); ht. *Ocyplanus proeses* QM F5512 (e); rf. *Ocyplanus proeses* (ht. *Phoeniconaias gracilis*) SAM P13650 (f); Bush Stone-Curlew, *Burhinus magnirostris*, ANWC BS1855 (g); Banded Stilt, *Cladorhynchus leucocephalus*, SAM B31542 (h). Measurements for Tables 9, 10, 11 and 12 and Figure 7 are indicated as follows: WS = width of shaft at proximal end of distal foramen, WD = width of distal end, IDII = internal depth of trochlea II, EDII = external depth of trochlea II, AWII = anterior width of trochlea II, PWII = posterior width of trochlea II, IDIII = internal depth of trochlea III, EDIII = external depth of trochlea III, AWIII = anterior width of trochlea III, PLIII = posterior length of trochlea III, IDIV = internal depth of trochlea IV, PWIV = posterior width of trochlea IV.

are congeneric or not with extant genera, and indeed where species boundaries should be drawn. Differences can be observed, but how much this is related to variability within a taxon and how much a reflection of real taxonomic difference is not yet clear. We, therefore, for convenience, have retained the following names for four size categories: *Xenorhynchopsis tibialis* de Vis, 1905; *Phoenicopterus ruber* Linnaeus, 1758; *Xenorhynchopsis minor* de Vis, 1905; and *Ocyplanus proeses* de Vis, 1905. Only when larger samples are known will an assessment approaching that of modern species be possible.

Xenorhynchopsis tibialis

Citation: de Vis, 1905. *Ann. Qd Mus.* 6: 9-10, pl. I., fig. 6.

SYNTYPES: QM F5515 and F5516, distal ends of a right and a left tibiotarsus, Lower Cooper Creek, South Australia, Quaternary.

De Vis described QM F5515 and F5516 as syntypes of a new genus and species of stork, Ciconiidae. They are similar in size to the tibiotarsi

of the Black-necked Stork or Australian Jabiru, *Ephippiorhynchus (Xenorhynchus) asiaticus*, with which he compared it. QM F5515 and F5516 resemble the tibiotarsi of Phoenicopteridae and differ from those of Ciconiidae, in distal view, by being decidedly broader anteriorly than they are posteriorly, by having a very prominent ligamental attachment at the base of the supratendinal bridge, and a very deeply excavated anterior surface between the two condyles. QM F5515 and F5516 differ from the tibiotarsi of other Phoenicopteridae by being larger than those of the largest extant species *Phoenicopterus ruber* (Table 5); and in that the internal condyle projects decidedly farther distally than the external (Fig. 4).

Qualitative characters that may distinguish *Xenorhynchopsis* from other genera are rather questionable: in *X. tibialis* the distal end appears deeper relative to width; the shaft flares less at the distal end; the ligamental groove on the lateral side of the shaft is located relatively nearer the anterior border. It appears to differ from *Leakeyornis* in that the ligamental prominence on the distal end

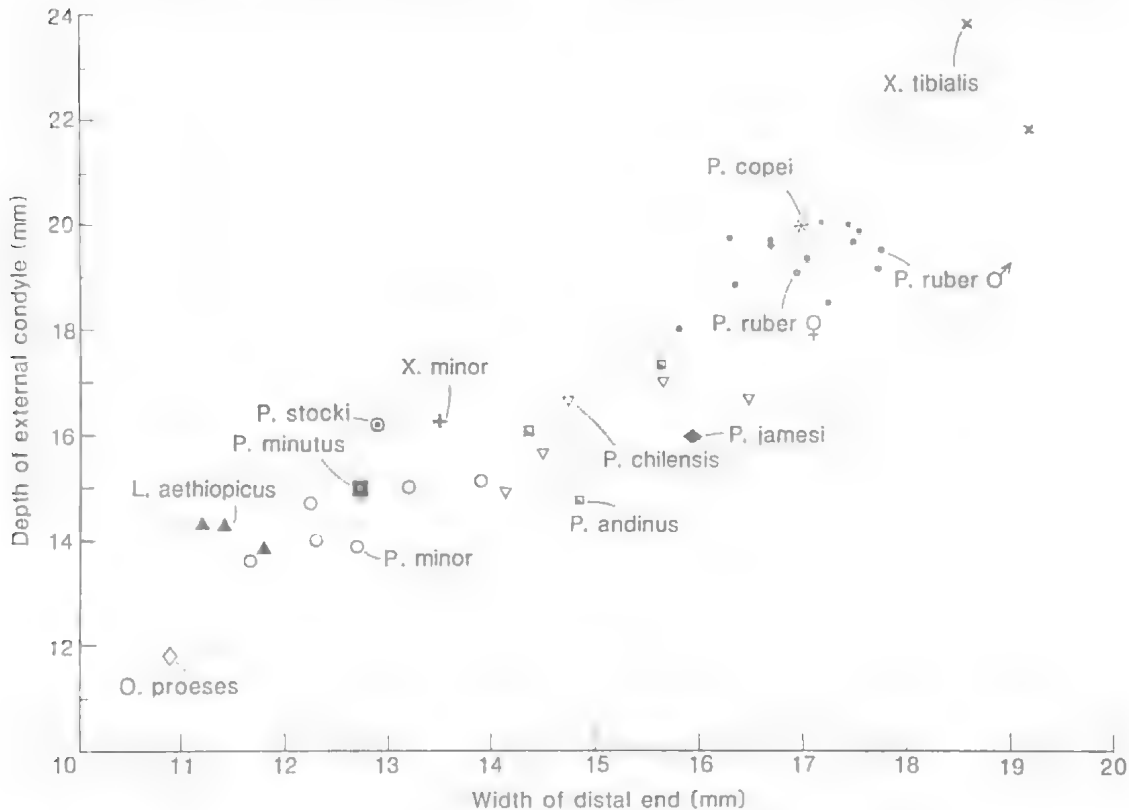


FIG. 6. Comparison of distal tibiotarsal measurements of extant and extinct species of flamingo.

of the supratendinal bridge is not subdued, and the supratendinal canal is broader. Direct comparison with *Phoeniconotius* is not possible, as that genus is known only from a tarsometatarsus and phalanges.

We hereby designate QM F5515 as the lectotype of *Xenorhynchopsis tibialis* and refer QM F5516 to *X. tibialis*.

ADDITIONAL REFERRED MATERIAL

Humerus: UCMP 56324, left distal fragment, Cooper Creek, site 8, UCMP V-5860, South Australia, Malkuni Fauna, Katipiri Sands; collected as float from a river channel in the western fork of Cooper Creek about one-half mile south of Kittipirra, Quaternary.

In shape, this humerus differs from that of the extant genera of flamingoes in having a relatively deeper brachial depression; a relatively shorter ventral supracondylar tubercle that is concave palmarly, not flat; and perhaps a more inflated distal end. More complete material is needed to accurately estimate the degree of inflation, however. The humerus differs from that of *Leakeyornis* in that the internal condyle does not

extend further distally relative to the external condyle than in modern genera; the condyles appear to be relatively more inflated, and the distal end is deeper relative to its width (Tables 3, 4 & 11).

Phoenicopterus ruber

Citation: Linnaeus, 1758. *Syst. Nat.* ed. 10, 1: 139.

REFERRED MATERIAL

Tarsometatarsus: QM F5518, right distal fragment, Wurdululmankula, South Australia, age uncertain.

De Vis (1905) referred this tarsometatarsus to *Xenorhynchopsis minor*, as a species of stork smaller than his *X. tibialis*. QM F5518 is similar in shape to the tarsometatarsi of Phoenicopteridae in the position of the trochlea for digit II being more ventral than in Ciconiidae. QM F5518 is decidedly more mediolaterally compressed than in *Phoenicoparrus*, and thus more like this element in *Phoeniconais* and *Phoenicopterus*. QM F5518 is similar in size and shape to small tarsometatarsi of *P. ruber*; it does appear to differ slightly from our sample of *P. ruber*, however, in having a

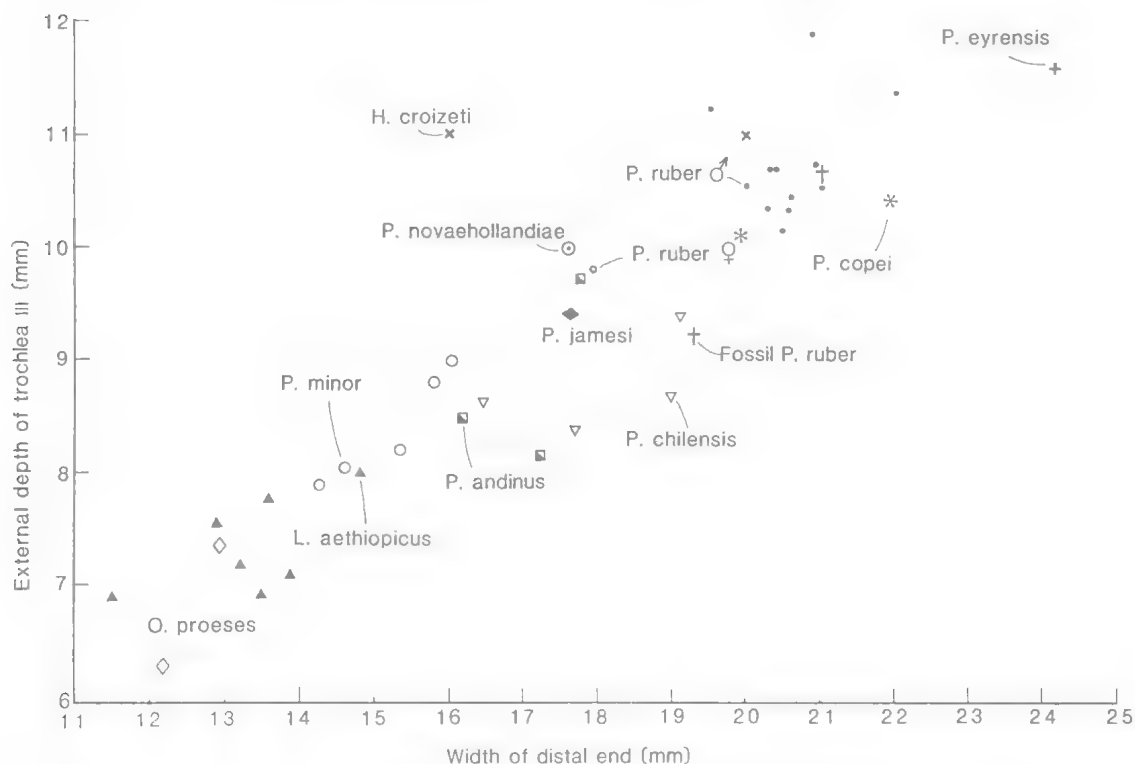


FIG. 7. Comparison of distal tarsometatarsal measurements of extant and extinct species of flamingo.

relatively shallower trochlea IV, although there is definitely some wear on the bone that might have overemphasized this. *P. copei* is similar in size to *P. ruber* (Tables 8, 10 and 12), but according to Shufeldt (1892) has longer wings, legs and toes, and a coracoid with a narrower dorsal end. These are characters that are not available for comparison in the Pliocene and Quaternary material of Australian flamingoes. For the present, because of its size we provisionally refer QM F5518 to *P. ruber*.

Femur: QMF 7013 left, proximal fragment, probably from northeastern South Australia.

This femur was found in the de Vis collection in the Queensland Museum with no information as to its origin. It is not one of the few missing specimens that were described by de Vis. Its

preservation is compatible with that of fossil material from northeastern South Australia.

In shape and size, QMF 7013 is similar to the femur of a large *Phoenicopterus ruber*, to which species we tentatively refer it. It differs from *Leakeyornis* in having a flat anterior shaft surface near the proximal end and a posterior expansion of the trochanter.

Tibiotarsus: UCMP 60562, left distal fragment, Stirton Quarry, Lake Kanunka, Site 1, UCMP V-5772, South Australia, Tirari Formation, Pliocene. This tibiotarsus was found at the base of an escarpment on the northeast side of the northern part of the bluffs immediately to the west of Lake Kanunka. It differs slightly in shape from that of *P. ruber* in that the tendinal canal is decidedly deeper and broader, and the tendinal

TABLE 3. Measurements in mm of the humeri of Australian Quaternary flamingoes.

	<i>X. tibialis</i>	<i>X. minor</i>	
	UCMP 56324 rf	UCMP 56360 rf	UCMP 56882 rf
Width of distal end		@22	@19
Length of external condyle	15.2	11.6	9.8
Depth of external condyle	15.8	11.8	10.5
Depth of internal condyle	9.1		5.9
Depth at attachment of <i>M. pronator brevis</i>	12.7	>8.6	7.8

TABLE 4. Measurements in mm of the humeri of modern flamingoes.

		<i>P. ruber</i> ♂	<i>P. ruber</i> ♀	<i>P. chilensis</i>	<i>P. andinus</i>	<i>P. minor</i>
Width of distal end	\bar{x}	25	23	23.5	22	19
	range	23-26	—	23-24	—	18-21
	n	13	1	3	1	3
	sd	0.8	—	0.5	—	1.4
Length of external condyle	\bar{x}	14	12	14	11	10
	range	12-15	—	14-15	—	9-11
	n	13	1	3	1	3
	sd	1.0	—	0.3	—	0.5
Depth of external condyle	\bar{x}	15	13	14	13	11
	range	13-16	—	12-15	—	10-12
	n	13	1	3	1	3
	sd	0.7	—	1.0	—	0.8
Depth of internal condyle	\bar{x}	9	9	9	8	7
	range	8-10	—	9-10	—	6-8
	n	13	1	3	1	3
	sd	0.7	—	0.3	—	0.7
Depth at attachment of <i>M. pronator brevis</i>	\bar{x}	10	10	9	—	8
	range	9-11	—	9-9	—	—
	n	11	1	3	—	1
	sd	0.5	—	0.2	—	—

TABLE 5. Measurements in mm of the femora of Australian Quaternary flamingoes.

	<i>P. ruber</i>	<i>O. proeses</i>
	QM F7013 rf	QM F5519 rf
Width of proximal end	>18.6	@13.6
Width of distal end	—	@15.1
Depth of trochanter	—	>9.1
Depth of head	@10.1	@6.2

groove on the lateral side of the external condyle is displaced farther anteriorly than in any of the modern genera. It differs from the tibiotarsus of *Leakeyornis* in having a very prominent ligamental attachment on the distal end of the tendinal bridge and in having a deeply incised tendinal canal. In size, UCMP 60562 agrees with *Phoenicopterus ruber*, to which we provisionally refer it.

Tarsometatarsus: UCMP 60583, right distal fragment, Lake Kanunka, Site 1, UCMP V-5772, South Australia, Tirari Formation, Pliocene.

TABLE 6. Measurements in mm of the femora of modern flamingoes.

		<i>P. ruber</i> ♂	<i>P. ruber</i> ♀	<i>P. chilensis</i>	<i>P. andinus</i>	<i>P. minor</i>
Width of proximal end	\bar{x}	23	21	20	20	17
	range	20–24	—	18–22	19–20	15–18
	n	13	1	6	3	5
	sd	1.0	—	1.2	0.7	1.0
Width of distal end	\bar{x}	26	24	23	22	18
	range	24–27	—	23–24	—	17–20
	n	13	1	3	1	3
	sd	0.8	—	0.4	—	1.3
Depth of trochanter	\bar{x}	18	17	17	15	13
	range	17–20	—	16–17	—	12–14
	n	13	1	3	1	3
	sd	0.9	—	0.5	—	0.5
Depth of head	\bar{x}	10	9	10	9	7
	range	9–11	—	8–10	8–10	6–8
	n	13	1	6	3	5
	sd	0.4	—	0.7	0.6	0.5

TABLE 7. Measurements in mm of the tibiotarsi of Australian Quaternary flamingoes.

	<i>X. tibialis</i>		<i>P. ruber</i>	<i>X. minor</i>		<i>O. proeses</i>
	QM F5515 lt	QM F5516 rf	UCMP 60562 rf	QM F5517 ht	UCMP 94688 rf	UCMP 56887 rf
Width of distal end	@19.2	18.6		13.5	>14.9	10.9
Depth of internal condyle		>22.3	19.3	15.9		
Depth of external condyle	21.8	>23.8		16.3		>11.8
Anterior length of internal condyle			8.8	6.9	@7.7	5.8
Anterior length of external condyle	11.5	@9.2		9.0		6.5

Miller (1963) described and figured this tarsometatarsus, similar in size and shape to a large tarsometatarsus of *Phoenicopterus ruber*, to which species he referred it. We tentatively agree with this referral.

Xenorhynchopsis minor

Citation: de Vis, 1905. *Ann. Qd Mus.* 6: 10, pl. I, II, fig. 1.

HOLOTYPE: QM F5517, distal end of a right tibiotarsus, Unduwampa, South Australia, Quaternary.

De Vis described QM F5517 as the holotype of a small species of stork in his genus *Xenorhynchopsis*. In size and shape the holotype is similar to *Phoeniconaias minor*, except that the shaft is somewhat stouter in *Xenorhynchopsis minor*. In *X. minor* the external condyle is deeper relative to distal end width, the internal condyle is relatively shorter, and there is a greater difference

in the lengths of the internal and external condyles when they are viewed anteriorly than in *P. minor*. The tibiotarsus of *X. minor* is larger than that in *Leakeyornis aethiopicus* (Tables 7 & 11), and it differs in having a very large distal opening of the tendinal canal, but it is very similar in all other characters. Like in *Xenorhynchopsis tibialis*, the condyles of *X. minor* are deeper relative to width, and thus *Xenorhynchopsis* differs from the living genera and *Leakeyornis*. Both *X. tibialis* and *X. minor* flare only slightly distally, apparently not as much as in the living genera, and both have very large distal openings of the tendinal canal; neither have a deeply notched distal border of the internal condyle, thus differing from the species in modern genera. *Phoenicopterus stocki* (Miller 1944) from the Pliocene of North America and *P. minutus* (Howard 1955) from the Pleistocene of North America are both about the same size as *X. minor*

TABLE 8. Measurements in mm of the tibiotarsi of modern flamingoes.

		<i>P. ruber</i> ♂	<i>P. ruber</i> ♀	<i>P. chilensis</i>	<i>P. andinus</i>	<i>P. jamesi</i>	<i>P. minor</i>
Width of distal end	\bar{x}	17	16	15	15	16	13
	range	16–18	—	14–17	14–16	—	12–14
	n	13	1	6	3	1	6
	sd	0.6	—	1.0	0.7	—	0.8
Depth of internal condyle	\bar{x}	20	18	16	16	16.5	15
	range	19–20	—	15–17	15–18	—	14–15
	n	13	1	6	3	1	6
	sd	0.6	—	0.6	1.1	—	0.5
Depth of external condyle	\bar{x}	19	18	16	16	16	14
	range	19–20	—	15–17	15–17	—	13–15
	n	13	1	6	3	1	6
	sd	0.6	—	0.8	1.2	—	0.6
Anterior length of internal condyle	\bar{x}	10	9	8	8	7.5	7
	range	9–11	—	8–9	—	—	6–8
	n	13	1	3	1	1	4
	sd	0.6	—	0.6	1.1	—	0.5
Depth of external condyle	\bar{x}	19	18	16	16	16	14
	range	19–20	—	15–17	15–17	—	13–15
	n	13	1	6	3	1	6
	sd	0.6	—	0.8	1.2	—	0.6
Anterior length of internal condyle	\bar{x}	10	9	8	8	7.5	7
	range	9–11	—	8–9	—	—	6–8
	n	13	1	3	1	1	4
	sd	0.5	—	0.6	—	—	0.4
Anterior length of external condyle	\bar{x}	11	10	9	9	9	8
	range	10–12	—	8–9	—	—	8–9
	n	13	1	4	1	1	4
	sd	0.5	—	0.3	—	—	0.4

(Tables 7, 8 & 12), and both appear also to have deep condyles, with *P. stocki* being deepest (Howard 1955). *P. minutus* has a relatively shorter internal condyle, evidently a relatively higher intercondylar tubercle (Howard 1955), a notch on the distal border of the internal condyle that is well behind the centre of the condyle, not near its centre, and the shaft flares more broadly at the distal end. *X. minor* appears to differ from both *P. stocki* and *P. minutus* in having a relatively

broad intercondylar notch, as in living flamingoes, rather than a narrow one.

REFERRED MATERIAL

Tibiotarsus: UCMP 94688, left distal fragment, Cooper Creek, Site 4, UCMP V-5380, South Australia, Malkuni Fauna, Katipiri Sands, Quaternary. Collected from a sandbar in the main channel of Cooper Creek.

This tibiotarsus is similar in size to those of

TABLE 9. Measurements in mm of the tarsometatarsi of Australian Quaternary flamingoes.

	<i>P. ruber</i>		<i>O. proeses</i>		
	QM F5518 rf	UCMP 60583 rf	QM F5512 ht	SAM P13650 rf	UCMP 60561 rf
Width of shaft at proximal end of distal foramen	14.2		8.6	9.8	
Width of distal end	@ 19.2	> 21.0	12.2	13.0	
Internal depth of trochlea II				6.1	
External depth of trochlea II	7.4	> 8.1	5.1	6.0	5.8
Anterior width of trochlea II	> 6.4	9.1	@ 4.2	4.7	5.2
Posterior width of trochlea II	> 4.8			3.1	
Internal depth of trochlea II	3.9	10.6	6.1		6.9
Anterior width of trochlea II	> 6.4	9.1	@ 4.2	4.7	5.2
Posterior width of trochlea II	> 4.8			3.1	
Internal depth of trochlea III	8.9	10.6	6.1		6.9
External depth of trochlea III	9.2	10.7	6.3	7.4	> 7.2
Anterior width of trochlea III	> 7.4	> 7.9	> 4.8	> 5.1	> 5.4
Posterior length of trochlea III	@ 10.6	10.9	9.0	> 8.1	
Internal depth of trochlea IV	> 7.7			6.2	
Posterior width of trochlea IV	5.8			3.2	

TABLE 10. Measurements in mm of the tarsometatarsi of modern flamingoes.

		<i>P. ruber</i> ♂	<i>P. ruber</i> ♀	<i>P. chilensis</i>	<i>P. andinus</i>	<i>P. jamesi</i>	<i>P. minor</i>
Width of shaft at proximal end of distal foramen	\bar{x} range n sd	15 14-17 12 0.8	13 — 1 —	15 14-15 3 0.1	11 — 1 —	14 — 1 —	12 11-13 3 0.7
Width of distal end	\bar{x} range n sd	21 19-22 12 0.6	18 — 1 —	18 16-20 6 1.1	17 16-18 3 0.8	18 — 1 —	15 14-16 5 0.8
Internal depth of trochlea II	\bar{x} range n sd	8 7-10 12 0.5	7 — 1 —	7 7-8 5 0.4	— — — —	— — — —	7 — 1 —
External depth of trochlea II	\bar{x} range n sd	9 8-10 12 0.8	7.5 — 1 —	8 7-9 5 0.6	7 6-8 3 0.9	7 — 1 —	6 6-8 6 0.5
Anterior width of trochlea II	\bar{x} range n sd	7 6-8 12 0.4	7 — 1 —	6 4-7 6 0.9	7 — 1 —	7 — 1 —	5 4-6 4 0.8
Posterior width of trochlea II	\bar{x} range n sd	5 5-6 12 0.3	— — — —	5 4-5 4 0.3	5 4-5 3 0.3	5 — 1 —	4 3-5 5 0.4
Internal depth of trochlea III	\bar{x} range n sd	11 10-11 11 0.5	10 — 1 —	9 8-10 5 0.4	9 8-11 3 1.3	9 — 1 —	8 8-9 5 0.4
External depth of trochlea III	\bar{x} range n sd	11 10-12 12 0.5	10 — 1 —	9 8-10 5 0.5	9 8-10 3 0.8	9 — 1 —	8 8-10 5 0.5
Anterior width of trochlea III	\bar{x} range n sd	8 8-9 12 0.4	8 — 1 —	7 5-8 5 1.2	7 — 1 —	7 — 1 —	6 6-7 3 0.5
Posterior length of trochlea III	\bar{x} range n sd	12 11-13 12 0.5	10 — 1 —	10 9-11 3 1.1	10 — 1 —	11 — 1 —	9 9-10 3 0.9
Internal depth of trochlea IV	\bar{x} range n sd	10 9-11 12 0.5	9.5 — 1 —	8 8-9 5 0.3	8 7-8 3 0.6	8 — 1 —	7 7-8 5 0.3
Posterior width of trochlea IV	\bar{x} range n sd	6 5-7 12 0.3	5 — 1 —	5 5-6 4 0.4	5 4-5 3 0.3	5 — 1 —	4 4-4 6 0.1

Phoenicopterus minor. It is very heavily weathered, and we only tentatively refer it to *Xenorhynchopsis minor* on the basis of size.

Humerus: UCMP 56360, left distal fragment, Cooper Creek, site 14, UCMP V-5866, South Australia, Malkuni Fauna, Katipiri Sands. Collected from the northern side of the channel at a prominent west bend, where bones were found

in place or as float derived from a sand-filled channel cut into red-green mottled arenaceous clays and overlain disconformably by a grey-brown argillaceous sandstone and dune sands.

On UCMP 56360 and the humeri of *Phoenicopterus* the dorsal supracondylar process is not as prominent as it is in *Phoeniconaias* and *Phoenicoparrus*. UCMP 56360 differs from the

TABLE 11. Measurements in mm of the humeri, femora, tibiotarsi and tarsometatarsi of Tertiary flamingoes of the World from Rich and Walker (1983).

	<i>L. aethiopicus</i> range	n	<i>H. croizeti</i> range	n	<i>P. eyrensis</i> n = 1	<i>P. novaehollandiae</i> n = 1	<i>P. floridanus</i> n = 1
HUMERUS							
Width of distal end	16-18	7					
Length of external condyle	9-10.5	8					
Depth of external condyle	9-10.5	8					
FEMUR							
Width of distal end	15-18.5	3					
TIBIOTARSUS							
Width of distal end	11-12	3	15.9	1			16.5
Depth of internal condyle	12-14	3	11.5	1			
Depth of external condyle	@14	3	18.5	1			
Anterior length of internal condyle	6-7	2	8.5	1			
Anterior length of external condyle	7-8	2	10.1	1			
TARSOMETATARSUS							
Width of distal end	11-15	7	16-20	2	@24.4	17.6	
External depth of trochlea II	5-7	6			9.2	8.4	
Anterior width of trochlea II	4.5-5	4	4.5	1	8.7	6.6	
Internal depth of trochlea III	7-8	5	10.5	1	11.2	9.8	
External depth of trochlea III	7-9	9	11.0	1	11.6	10.0	
Anterior width of trochlea III	5-6	4	7-9	2	11.5	7.8	
Posterior length of trochlea III	7-9	7			10.9	@10	
Internal depth of trochlea IV	6-7	9				9.7	
Posterior width of trochlea IV	3.5-5	7	6.0	1		5.6	

humerus of *Leakeyornis* in having: only a small area of the brachial depression that is deep; the internal condyle not extending much beyond the external condyle; and the condyles inflated as in living flamingoes. Miller (1963) referred UCMV 56360 to *Phoenicopterus ruber*, because it is similar in size and shape to the humerus of UCMVZ 140923, labelled as a male of *Phoenicopterus ruber ruber*. The tarsometatarsal length of UCMVZ 140923 is 253 mm, which is within the range for males of *Phoenicopterus ruber chilensis*, and of females of *P. r. ruber* and *P. r. roseus*, but is too small for males of *P. r. ruber* and *P. r. roseus* as indicated in Blake (1977) and Cramp (1977). Our other measurements also suggest that UCMVZ 140923 has been mislabelled and misidentified and should be referred to *P. chilensis* rather than to *P. ruber*. We tentatively refer UCMV 56360 to *Xenorhynchopsis minor*, in part because it is slightly smaller than our sample of *P. chilensis* (including UCMVZ 140923), substantially smaller than our sample of *P. ruber*, and slightly larger than our sample of *Phoeniconaias minor*.

Humerus: UCMV 56882, left distal fragment, Lake Kanunka, Site 1, UCMV V-5772, South Australia, Tirari Formation, Pliocene.

Miller (1963) referred this humerus to *Phoeniconaias gracilis*, but noted that in size it was similar to *Phoeniconaias minor*. Mainly because of its size we tentatively refer it to *Xenorhynchopsis minor*.

Ocyplanus proeses

Citation: de Vis, 1905. *Ann. Qd Mus.* 6: 8-9, pl. I, fig. 5b.

New Synonymy:

Ibis (?) *conditus* de Vis, 1905. *Ann. Qd Mus.* 6: 10-11, pl. II, fig. 2.

Phoeniconaias gracilis Miller, 1963. *Condor* 65: 294-6, fig. 4.

HOLOTYPE OF *OCYPLANUS PROESES*

Tarsometatarsus: QM F5512, left distal fragment, northeastern South Australia, age uncertain. Although the distal end is solidly fused, the shaft has a surface texture that suggests a juvenile bird.

De Vis did not specify where QM F5512 was found when he named it as a new genus and species of wader, Charadrii (= Limicolae). Without any explanations *Ocyplanus proeses* was included with the gulls, Laridae, by Lambrecht (1933), Brodkorb (1967) and Fisher (1983), and with the rails, Rallidae, by Condon (1975). When compared with QMF 5512 and the tarsometatarsi of waders and flamingoes, those of gulls and rails differ in that from a medial view the medial part of the trochlea for digit II is more rounded.

We agree with de Vis that QM F5512 is similar in size to the tarsometatarsus of a stone-curlew, *Burhinus magnirostris*, but QM F5512 and the tarsometatarsi of flamingoes differ from stone curlews in having a more gradual expansion of the distal end, and also in that the trochlea for digit II does not extend as far distally relative to that

TABLE 12. Measurements in mm of the tibiotarsi and tarsometatarsi of North American Quaternary flamingoes from Shufeldt (1884), Miller (1944), Howard (1955) and Rich and Walker (1983).

	<i>P. minutus</i> n = 1	<i>P. stocki</i> n = 1	<i>P. copei</i> n = 2
Tibiotarsus			
Width of distal end	12.7	@13	17
Depth of external condyle	@15	*16.2	20
Anterior length of interior condyle		6.2	
Tarsometatarsus			
Width of distal end			20-22
External depth of trochlea II			8.6-9.4
Anterior width of trochlea II			7.6-8.6
Internal depth of trochlea III			10.1-10.6
External depth of trochlea III			10.6-10.7
Anterior width of trochlea III			7.9-9.4
Posterior length of trochlea III			11.3-12.8
Internal depth of trochlea IV			9.4-10.5
Posterior width of trochlea IV			5.2-6.2

* 16.0 in Howard (1955).

for digit III. In these respects QM F5512 and the tarsometatarsi of flamingoes resemble those of some other waders with long, slender legs such as lapwings, *Vanellus*, Charadriidae; avocets and stilts, *Recurvirostra*, *Himantopus* and *Cladorhynchus*, Recurvirostridae; curlews and godwits, *Numenius* and *Limosa*, Scolopacidae; and pratincoles, *Stiltia*, Glareolidae; but their trochleae for digit II extend even less distally than those in QM F5512 and flamingoes (Fig. 5).

QM F5512, the holotype of *Ocyplanus proeses*, conforms to the diagnosis by Miller (1963) for *Phoeniconaias gracilis* (see below) and is similar in size and shape to the holotype. It differs from the tarsometatarsi of *Phoenicoparrus* and *Phoenicopterus* in being more mediolaterally compressed when viewed distally, thus resembling the tarsometatarsus of the living *Phoeniconaias*.

HOLOTYPE OF *IBIS* (?) *CONDITUS*

Femur: QM F5519, left, Wurdulumankula, South Australia, age uncertain.

De Vis (1905) made this femur the holotype of a new species of ibis, Threskiornithidae (= Irididae). He compared the femur with that of the Straw-necked Ibis, *Threskiornis* (*Carphibis*) *spinipectus*, and noted that the shaft of QM F5519 was relatively stout compared with the length of the femur. In this respect QM F5519 is similar to the femora of Phoenicopteridae, as it is also in other respects, including the sharply curved line in the popliteal area mentioned by de Vis.

The femur differs from that of all living genera of flamingoes in that the anterior intermuscular line is straight over much of its length except near the proximal end where it is highly concave, curving medially to touch the trochanter; the anterior face of the shaft near the proximal end is deeply excavated and lacks a pneumatic foramen (Lambrecht 1933); the ligamental pit at the base of the fibular condyle, when viewed posteriorly, is relatively deeper, and a distinct ridge lies just proximal to that; proximal to the prominent ridge is a deep channel that runs onto the shaft (modern flamingoes lack the well defined channel, and the ridge is only hinted at).

In size, QM F5519 is smaller than the femora of *Phoeniconaias minor* and is from a bird similar in size to QM F5512; we, therefore, refer QM F5519 to *Ocyplanus proeses*.

HOLOTYPE OF *PHOENICONAIS GRACILIS*

Tarsometatarsus: SAM P13650, left distal fragment, Lake Kanunka, Site 1, UCMP V-5772 South Australia, Tirari Formation, Pliocene.

Miller (1963) described this tarsometatarsus as the holotype of a new species of flamingo with a tarsometatarsus smaller and more slender than that of *Phoeniconaias minor*, the smallest extant species of flamingo. He suggested that the fossil resembled most the African *Phoeniconaias*, because it had a trochlea II that was relatively shallow and less rounded than in other living genera. This seems variable within our samples of living genera. The tarsometatarsus of *Phoeniconaias* is however, like the Australian fossil, more mediolaterally compressed than those in the species of *Phoenicoparrus* and *Phoenicopterus*. *P. gracilis* differs from *Leakeyornis* in that trochlea IV is narrower posteriorly and deeply incised laterally, and in distal view, the tarsometatarsus is more compressed mediolaterally. *Phoeniconotius* has much shallower trochleae relative to their width and a less compressed distal end. We agree with Miller's diagnosis, which equally applies to the holotype of *Ocyplanus proeses*, a name that has priority and to which we refer SAM P13650, the holotype of *Phoeniconaias gracilis*.

ADDITIONAL REFERRED MATERIAL

Tibiotarsus: UCMP 56887, right distal fragment, Lake Kanunka, Site 1, UCMP V-5772, South Australia, Tirari Formation, Pliocene.

Miller (1963) referred this tibiotarsus to *Phoeniconaias gracilis*, because it is smaller than that of *P. minor*, which it resembles in shape. It further differs from all of the extant flamingoes we examined in that: the ligamental groove on the external shaft surface near the distal end lies close to the anterior border of the shaft and does not course diagonally across that surface; and the distal end is not flattened distally, but both internal and external condyles slope proximally and posteriorly, although this is certainly overemphasized by postdepositional wear. It differs from the tibiotarsus of *Xenorhynchopsis tibialis* in flaring more broadly distally, in having less prominent ligamental protuberances on the anterior surface, and in having the ligamental groove on the lateral face of the external condyle located more anteriorly. It differs from the tibiotarsus UCMP 60562, that we tentatively refer to *Phoenicopterus ruber*, in having a decidedly deeper tendinal canal on the anterior surface and relatively higher ligamental prominences. It differs from the tibiotarsus of *Xenorhynchopsis minor* in that the condyles, viewed from the side, have a more pronounced slope proximoposteriorly. We refer UCMP 56887 to *Ocyplanus proeses*.

Tarsometatarsus: UCMP 60561, right distal fragment, Lake Kanunka, Stirton Quarry, Site 1, UCMP V-5772 South Australia. Found as float, Pliocene or Quaternary.

Miller (1963) referred this tarsometatarsus to *Phoeniconaias gracilis*. It is slightly smaller than the smallest individual in our *P. minor* sample and poorly preserved. We tentatively refer UCMP 60561 to *Ocyplanus proeses*.

Phoenicopteridae, indet.

Sternum: UCMP 69588, anterior fragment, locality uncertain, South Australia.

Sternum: UCMP 128455, anterior fragment of a juvenile, Manku, Kallakoopah Creek, UCMP V-76056, South Australia, Quaternary.

Both UCMP 69588 and 128455 are fragments of the manubrial end of the sternum. The manubrial spine is preserved complete in 69588. UCMP 128455 appears to be a juvenile, based on the porous appearance of the bone surface and its small size. On the ventral side the angle of lateral spread posteriorly between the coracoidal sulci is greater than in *Phoenicopterus ruber*, *P. chilensis* and *Phoeniconaias minor*, but the vertical depth of the coracoidal sulci is in the adult UCMP 69588 similar to *P. ruber*, and in the juvenile and worn UCMP 128455 less than in *P. ruber*. These characters might be diagnostic when more complete fossil sterna become available, but at this stage we can assign UCMP 69588 and UCMP 128455 only to indeterminate Phoenicopteridae.

DISCUSSION AND CONCLUSIONS

Modern genera of flamingo differ in the shapes of the mandibles and in the presence (*Phoenicopterus* and *Phoeniconaias*) or absence (*Phoenicoparrus*) of a hind toe (Salvadori 1895). Unfortunately *Phoenicopterus* and *Phoeniconaias* lack a hallux scar on the tarsometatarsus to indicate that they have a hind toe. *Phoeniconotus* is the only genus of flamingo known to have a hallux scar (Miller 1963; Rich and Walker 1983). Lambrecht (1933) noted that *Ocyplanus* did not have a hallux scar.

Brodkorb and Mourer-Chauvire (in press) believe that the post-cranial bones of flamingoes are of limited diagnostic value. As indicated above in the descriptions of the fossils, we, as did de Vis (1905) and Miller (1963), found some differences in shape, that may be generic, but more complete fossil material is needed to substantiate their significance. The only Pliocene and Quaternary material of Australian flamingoes available to de

Vis included seven, to Miller six, and to us 18 bones.

The limited evidence available suggests that sometime during this time period there were at least four species of flamingo, in what may be three different genera, and that they were restricted to the Lake Eyre Basin of northeastern South Australia.

The range in size and at certain stratigraphic levels the number of sympatric genera and species of the Pliocene and Quaternary flamingoes of Australia is greater than has been recorded elsewhere in time and space. *Xenorhynchopsis tibialis* appears to have been larger than any known flamingo except for *Phoeniconotus eyrensis* of the Australian Miocene, and *Ocyplanus proeses* appears to have been smaller than any known flamingo except for *Leakeyornis aethiopicus* of the African Miocene. *Xenorhynchopsis minor* appears to have been similar in size to *Phoeniconaias minor*, the Lesser Flamingo, and smallest of the five species of modern flamingoes; whereas *Phoenicopterus ruber*, the Greater Flamingo, is the largest of the modern flamingoes.

Xenorhynchopsis differs from other genera of flamingoes mainly in having a tibiotarsus with a relatively deep distal end, which flares little, especially on the lateral side.

Australian fossil flamingoes assigned to *Phoenicopterus ruber* are the size of this living species, but some elements demonstrate a few differences from this species and other known genera of flamingo. We, therefore, retain some of the Australian fossils in this genus for convenience only. It should be noted however, that we suspect that at least UCMP 60562 from Lake Kanunka may merit description as a new taxon when more diagnostic material is available.

In *Ocyplanus proeses*, we include *Ibis* (?) *conditus* and *Phoeniconaias gracilis*. Although the tarsometatarsi of *O. proeses* are qualitatively indistinguishable from those of *Phoeniconaias minor*, the referred femur and tibiotarsus differ markedly. Thus, because *O. proeses* does not conveniently fit into any known genus of flamingoes we have retained the de Vis name, which has priority.

It has not been feasible to date radiometrically the sites that have yielded flamingo bones, some of which were found as 'float' on erosion surfaces in creek beds. It appears that four species are known from the Cooper Creek localities (Table 1), three from Lake Kanunka, and one specimen from Kallakooa Creek. The Cooper Creek localities

may include sites of various ages within the Pleistocene. The six Kanunka fossils, however, probably represent contemporaneous Pliocene forms, suggesting that at least three species inhabited this area, which must have had permanent saline lakes in the Pliocene, and missing *Xenorhynchopsis tibialis* may represent a species restricted to the Pleistocene that frequently crops out along Lower Cooper Creek. The smallest flamingo, *Ocyplanus proeses*, occurs in both places but is restricted to only one Cooper Creek locale, Wurdulmankula, the age of which is uncertain. It has not been found anywhere together with *Xenorhynchopsis tibialis*, and could be restricted to the Pliocene. *X. minor* is long ranged, from Pliocene into the Quaternary.

How the Australian flamingoes are related to those elsewhere in the world cannot be determined until more complete material of fossil forms is available. It does seem clear that there were several kinds of flamingoes in Australia during the Pliocene and Quaternary (Rich and van Tets 1982) and, as happened in North America, increased aridity accompanied by the disappearance of reasonably permanent shallow lakes, and of feeding and breeding grounds, resulted during the Quaternary in major extinctions. In North America flamingoes survived in the Caribbean Basin, whereas the antipodean flamingoes left no survivors, even though Australia had hosted during the last 3–4 million years one of the most, if not the most, diverse flamingo faunas. Better dating of the sites containing flamingoes in Australia could provide significant data for timing of extinctions and reconstruction of changing palaeoenvironments.

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A NEW SPECIES AND NEW RECORDS OF *PORTUNUS* (DECAPODA :
PORTUNIDAE) FROM NORTHERN AUSTRALIA

P.J.F. DAVIE
Queensland Museum

ABSTRACT

Portunus rufiarcus is described as new. It differs from its closest relatives, *P. pubescens* and *P. convexus*, by its characteristic colouring, a continuous mesogastric ridge, and a distinctive first male pleopod. *P. pulchricristatus* and *P. tuberculosus* are recorded from Australia for the first time.

INTRODUCTION

Extensive shallow water trawling by the Queensland Fisheries Service (Q.F.S.) has been conducted in recent years. Amongst a variety of interesting material that has come to the Museum are three species of *Portunus*. Measurements given are of carapace widths including the last anterolateral spine. Synonymies cover the most important references but are not necessarily complete.

Portunus pulchricristatus (Gordon, 1931)
(Fig. 1)

Neptunus (*Hellenus*) *spinipes* Alcock, 1899: 31, 39.
non *Neptunus* (*Amphitrite*) *spinipes* Miers, 1886
Neptunus (*Hellenus*) *pulchricristatus* Gordon, 1931: 534,
figs 8, 10a.
Portunus pulchricristatus: Stephenson and Rees, 1967:
35. Stephenson, 1972a (record only). Stephenson
1972b (check-listing).

MATERIAL EXAMINED

QM W9913, 1 ♂ (23.3 mm), trawled off N. Queensland, 15°46.6'S, 145°42.1'E, 10.9.1979, 48.6 m, Q.F.S. QM W9916, 1 ♂ (25.5 mm), trawled off N. Qld, 16°08'S, 145°37'E, 11.9.1979, 43.2 m, Q.F.S. QM W9919, 1 ♂ (29.3 mm), trawled off N. Qld, 17°09.8'S, 146°23.5'E, 10.10.1979, 50.4 m, Q.F.S.

REMARKS

The specimens generally agree with the description of Gordon (1931), although length breadth ratios are slightly smaller (1.93 — 2.06 compared with 2.3 — 2.6). Nevertheless the last anterolateral spines are prominent, a feature which helps distinguish this species from *P. spinipes*. The other anterolateral teeth are slightly more defined than was figured by Gordon (1931) but they are not acute as in *P. spinipes*. Both of the above discrepancies could be accounted for by the

slightly smaller size of the present specimens. The first male pleopod agrees closely with the figures of both Gordon (1931) and Stephenson and Rees (1967, fig. 7).

DISTRIBUTION

Muscat; Madras; Andamans; Gulf of Martaban and Arakan Coast, Burma; Malaysian area; Philippines and China (Stephenson 1972b). Now from north Queensland, Australia.

Portunus tuberculosus (A. Milne Edwards, 1861)

Neptunus tuberculosus A. Milne Edwards, 1861: 333—4, pl. 31 (fig. 5).
Neptunus (*Amphitrite*) *tuberculosus*: Miers, 1886: 176.
Neptunus (*Hellenus*) *tuberculosus*: Alcock, 1899: 42—3.
Portunus tuberculosus: Stephenson and Campbell, 1959, p. 89 (in key). Crosnier, 1962: 69—71, figs 97—8, 124—7. Stephenson and Rees, 1967: 52, fig. 18, pl. 6B. Heath, 1971. Stephenson 1972a (record only), Stephenson 1972b (checklist).

MATERIAL EXAMINED

QM W12869, 1 ♂ (24.3 mm), trawled 'Red Spot Bycatch' Stn 2, E. of Hinchinbrook Is., 18°26'S, 146°25.4'E, 17.7.1985, Q.F.S. QM W9917, 1 ♀ (23.1 mm), trawled north Queensland, 17°08.7'S, 146°15.2'E, 43.2 m, 17.10.1979, Q.F.S. QM W2098, 1 ♀ (29.8 mm), Arnhem Bay, N.T., 10 fms, sand and mud bottom, V. Wells.

REMARKS

Agrees in all details with description given by Stephenson and Rees (1967).

DISTRIBUTION

Tanzania; Madagascar, Persian Gulf; Ceylon; China; Philippines; Palau Is. and Hawaii (Stephenson 1972b). Now from northern Australia.



FIG. 1: *Portunus pulchricristatus* (Gordon, 1931). Scale = 5mm.

***Portunus rufiarcus* sp. nov.**
(Figs 2a-d, 3)

MATERIAL EXAMINED

HOLOTYPE: 1 ♂ QM W12625 (27.1 mm), Bathurst Bay, FNQ. Beam-trawled, 1 m, over seagrass beds, C. Jones (Q.F.S.).

DESCRIPTION

Front: Four flat rounded lobes, equally protruberant and projecting well ahead of inner angles of orbit. Laterals only slightly broader at base than medians.

Anterolateral teeth: First, large triangular and blunt, projecting straight forward; the second to eighth of similar shape although gradually diminishing in size; the ninth about the same length as the first but sharply pointed and projecting forward.

Carapace: Moderately broad (breadth 1.58 times length), the anterolateral teeth form a curve whose centre lies at about the level of the cardiac groove. Postero-lateral angles rounded. Surface distinctly finely granulated particularly anterior to the epibranchial and mesogastric grooves,

becoming microscopic to almost smooth towards the posterior margin. Some sparse, small hairs across the anterior half, slightly longer on the borders of the anterolateral teeth. Paired branchial and metagastric ridges, but a continuous straight mesogastric ridge.

Chelipeds: Robust, pubescent, microscopically granulated. Posterodistal border of arm smooth; anterior border with three spines, the proximal spine the smallest, the median and distal spines subequal in length. Carpus with two carinae on outer face, the inferior one ending in a spine, the superior one blunt; and a carina on upper surface which also ends bluntly. Inside upper distal edge near hand articulation, with usual long spine. Outer upper distal edge without spine but carina bluntly pointed. Hand with three conspicuous carinae dorsally, the inner two ending in spines. Strong forwardly directed spine at point of upper articulation with carpus. Outer and inner faces both with median carinae ending bluntly. Dactyl with three carinae; fingers serrated; proximal tooth of right dactyl 'molar-like' and directed backwards.

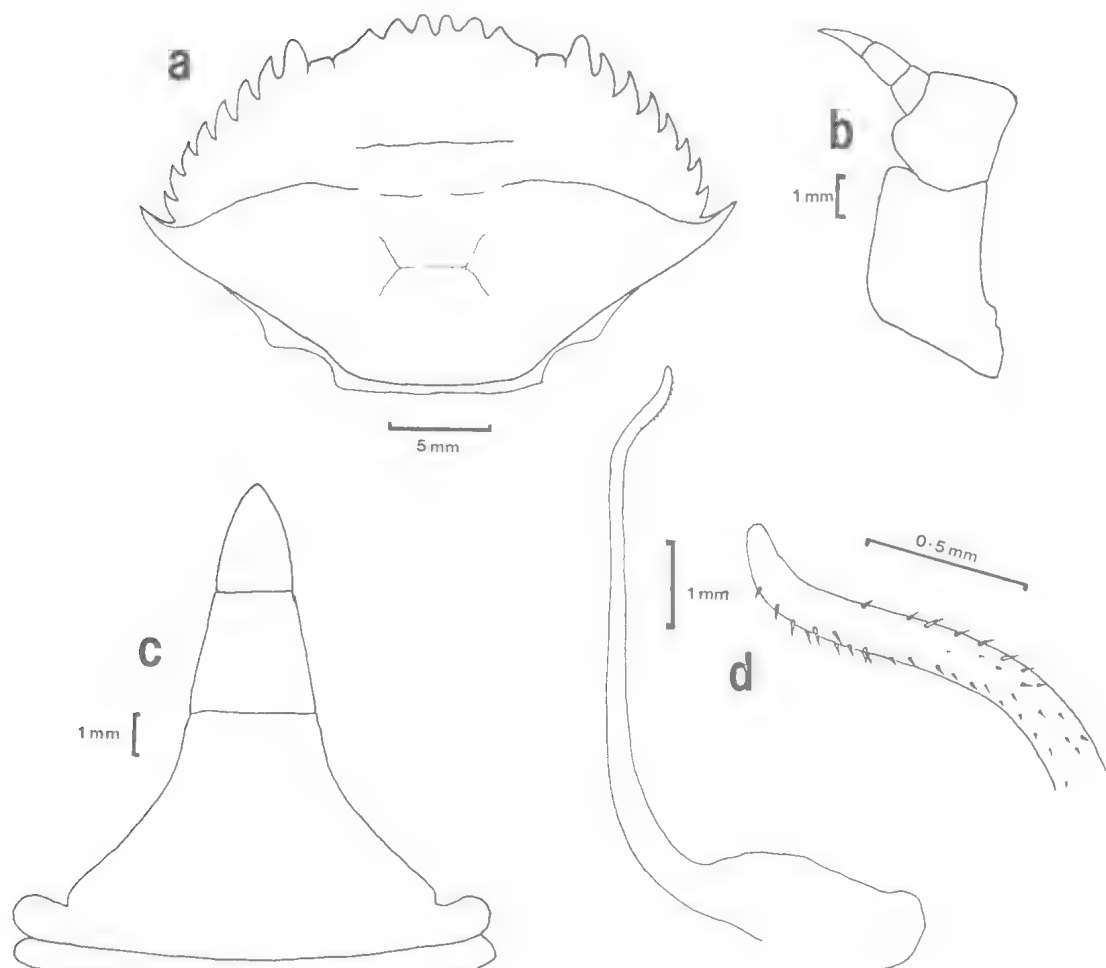


FIG. 2: *Portunus rufiarcus* sp. nov.: a — carapace; b — third maxilliped; c — male abdomen; d — left first male pleopod, whole view, and enlargement of sternal face of tip.

Fifth leg: Posterior surface with fine fringing hairs, no spines or spinules. Dactyl ends in small spine.

Third Maxilliped: Anteroexternal angle of merus not produced laterally but is square cut (Fig. 2b).

Male Abdomen: Gradually tapering, ultimate segment 1.7 times as long as broad at base, and only slightly shorter than length of penultimate (Fig. 2c).

First Male Pleopod: Long and thin, central section straight; recurved towards apex; gradually tapering to a slightly truncated tip. Abdominal surface of tip smooth, sternal face with sparse short bristles (Fig. 2d).

Colour: After approximately 6 months in alcohol the crab is generally a creamy yellow with

a uniform narrow arc of orange/red finishing at about the level of the penultimate anterolateral teeth. Two patches of the same colour but paler on either side of the mid-line, centred over the mesogastric ridge.

Fresh specimens have a much deeper red arc than preserved specimens. Behind this the colour is a rich red-brown becoming more orange until the epibranchial ridges. Behind these the carapace is yellow except for where the anterior colour extends back centrally for a short distance. The ambulatory legs are yellow, matching the posterior carapace colour. The chelipeds are a similar red to that behind the dark anterior arc.

REMARKS

Portunus rufiarcus is clearly most closely related to *P. pubescens* and *P. convexus* however both of

these have the mesogastric ridge broken.

It differs from *P. convexus* in other respects by: the shorter last anterolateral spines; the different shape of the frontal teeth (c.f. Fig. 60 in Crosnier, 1962); the merus of the third maxilliped having the anteroexternal angle more squarely cut (c.f. Fig. 69 in Crosnier, 1962); and in missing the characteristic posterolateral brown spots of that species. It resembles *P. convexus* particularly in the sinuous form of the first male pleopod, and in this respect both species differ from *P. pubescens* which has a smoothly curved male pelopod. It also differs from *P. pubescens* in the shape of the frontal teeth.

ETYMOLOGY

The species' name alludes to the distinctive colouring, and is from the latin words *rufus* meaning red, and *arcus* meaning an arc or bow.

ACKNOWLEDGEMENTS

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FIG. 3. *Portunus rufiarcus* sp. nov. Scale = 5mm.

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A Queensland Government Project
Typeset at the Queensland Museum

A NEW BARRED RIVER FROG (MYOBATRACHIDAE: MIXOPHYES)

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and

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ABSTRACT

Mixophyes fleayi sp. nov. has been confused with both *M. balbus* and *M. fasciolatus*, but it is readily separable from these species and the other two members of the genus. The new species is a ground-dweller in montane rainforest from Conondale Range, SE Queensland, to Richmond Range, NE New South Wales. Discovery of *M. fleayi* triggered new examination of the types of *Mixophyes* taxa about which there has been serious confusion. The status of *Hyla fenestrata* de Vis is confirmed as a junior synonym of *M. fasciolatus*, and probable types of *M. balbus* have been located in the Queensland Museum. Also, a lectotype is selected for *M. fasciolatus* Günther, 1864.

INTRODUCTION

Straughan (1968) recognised four species of Barred River Frogs, *Mixophyes* spp., from Australia: *M. balbus*, *M. fasciolatus*, *M. iteratus* and *M. schevilli*. In October 1972, we located a population of *Mixophyes* in Cunninghams Gap, SE Queensland. These specimens clearly differed from *M. fasciolatus* and *M. iteratus*, the only species of *Mixophyes* known from there. The frogs keyed to *M. fasciolatus* (following Straughan, *loc. cit.*) but we listed them as *M. balbus* (Ingram and Corben 1975), the species they most closely resembled. When we later collected live *M. balbus* (*sensu stricto*), we realized that our population belonged to a new species. We have examined the holotypes of *Mixophyes balbus* Straughan and *M. iteratus* Straughan, a paratype of *M. fasciolatus* *schevilli* Loveridge, and a syntype of *M. fasciolatus* Günther. The species we describe here is distinct from all of the known species of *Mixophyes*.

The following abbreviations are used: SV, snout-vent length; TL, tibial length; HW, width of head at broadest part; IN, distance between the two external nostrils; EN, distance between the external nostril and anterior border of eye; ED, diameter of eye between anterior and posterior borders. Measurements are in millimetres and ratios are expressed as percentages. Specimens examined are housed in the Queensland Museum (QM), South Australian Museum (SAM), Australian Museum (AM), and the British Museum (Natural History) (BMNH).

Mixophyes fleayi sp. nov.

MATERIAL EXAMINED

HOLOTYPE: Adult female, QM J 26901 Ballanjul Cascades, Lamington National Park, (28°12'S, 153°05'E), SE Queensland. Collected by M. Bishop, 5 April 1976.

PARATYPES: Cunninghams Gap, SEQ (J29930–1, 34101–3, 35461–5); Tambourine Mountain, SEQ (J32059); Canungra Gorge National Park, SEQ (J5198); near summit of Mt Superbus, near Warwick, SEQ (J30545–8); Mt Ballow, SEQ (J26469–70); Taroom Range, NE NSW (J34243–4, AM R123424); Brindle Creek, Wangaree, NE NSW (J27859); No locality data (SAM R31036).

DIAGNOSIS

M. fleayi (Fig. 1) can be distinguished from *M. schevilli* and *M. iteratus* by the amount of webbing on the toes (half-webbed vs fully webbed); from *M. balbus* by the colour pattern on the flanks (prominent black spotting on yellow vs immaculate apricot). Further, *M. fleayi* lacks a distinct, continuous, pale stripe along the upper lip, which is so characteristic of adult *M. fasciolatus* (Fig. 2).

DESCRIPTION OF HOLOTYPE

SV 89, TL 55, TL/SV 62.1, HW 36, HW/SV 40.4, HW/TL 65.1, ED 9.5, ED/HW 26.4, EN 7.0, IN 7.8, EN/IN 89.7. Dorsal aspect of snout blunt, but tapering; in profile, straight, steep, and forward sloping. Short supratympanic fold extending downwards to just past tympanum. Canthus rostralis distinct, concave. Tympanum large and oval-shaped, sloping backwards. Fingers

unwebbed, slightly expanded distally. Length of fingers from shortest to longest 1-2-4-3; large rounded tubercles proximally; large oval-shaped inner palmar tubercle about twice the size of the more elongated outer tubercle. Toes webbed; distal phalanges of the 1st, 2nd, and 5th toes free of web but fringed; distal two phalanges of the third, and distal three phalanges of fourth also have this condition. Length of toes from shortest to longest 1-2-3-5-4; low rounded tubercles proximally, with additional, smaller tubercles more distal on the 3rd, 4th and 5th toes; a large elongated inner metatarsal tubercle. Cloacal opening directed backwards at mid-level of the thighs.

Dorsal ground colour light brown with indistinct marbling; there is also a 'Y' shaped dark brown patch edged black, with the 'base' between the eyes, and 'arms' terminating above the groin. Lateral ground colour grey-brown grading to cream towards the venter; sides overlaid with large black spots. A dark line extends from behind the nares through the eye to behind the tympanum; a

large purplish-black marking below the eye, broadening down to the upper lip; a large similarly coloured marking peaks below and in front of the nares, flares out and terminates on the upper lip. Creamy yellow below; palms and soles black; tips of the fingers and tubercles on the hands creamy yellow. Back of thighs grey-brown with 7-8 black cross-bands.

VARIATION IN THE PARATYPES

There are 23 paratypes, SV 24-82 (mean 64.7), TL 15-52 (mean 42.4), TL/SV 61-69 (mean 65.4); HW 11-34 (mean 27.7), HW/SV 39-47 (mean 43.0), HW/TL 59-72 (mean 65.8), ED 4-10 (mean 7.8), ED/HW 25-33 (mean 28.3), EN 2-7 (mean 5.9), IN 3-8 (mean 6.8), EN/IN 72-98 (mean 85.9).

Pupil vertically oriented. Vocal sacs present in males. Dorsal ground-colouring can be dark brown; the dorsal 'Y' marking often is incomplete. Nuptial pads of males are dark brown; the thumb is thicker at base when compared to the female.



FIG. 1: *Mixophyes fleayi* sp. nov. from Cunningham's Gap, SE Queensland (Owen Kelly)

The throat and the underside of the thighs may be speckled with brown.

ETYMOLOGY

The species is named for the Australian naturalist, David Fleay.

DISTRIBUTION

M. fleayi is restricted to montane rainforests from the Conondale Range, SE Queensland (Ingram 1983), to the Richmond Range, NE New South Wales. *M. fleayi* has been found in sympatry with both *M. fasciolatus* and *M. iteratus*. It is allopatric with *M. balbus* — the dividing line is apparently the Clarence River, which separates the Richmond Range from the Gibraltar Range. The Gibraltar Range is the northernmost locality known for *M. balbus* (C. Corben pers. ob.).

FIELD NOTES

M. fleayi has two distinct calls. One of these is a throaty 'ok-ok-ok-ok-ok-ok', typically given by solitary males calling from under leaf-litter on the

rainforest floor. The other is a long, rasping 'arrrrrrrr', or growling call, given in chorus. Choruses are produced by males calling from exposed rocks in stream beds or from the edges of pools beside the streams. Eggs have been found under a rock about 30 cm from water and attended by an adult frog. The egg mass resembled that of *Pseudophryne*, but the capsules were much larger. Tadpoles resemble those of *M. fasciolatus* but are darker grey and more elongate.

Breeding aggregations are rarely encountered but seem to be associated with late spring thunderstorms on warm nights. More often, individuals are seen hiding under leaf-litter or sitting on paths through the rainforest. At O'Reillys, Lamington Plateau, they may be found with *M. fasciolatus* on the short grass of the picnic grounds but they do not range far from the rainforest.

IDENTIFICATION

The toes are only partly webbed like those of *M. balbus* and *M. fasciolatus*; this distinguishes



FIG. 2: *Mixophyes fasciolatus* from Mt Lamington, SE Queensland (Owen Kelly).

M. fleayi from *M. schevilli* and *M. iteratus*, both of which have fully webbed toes, *M. fleayi* is not known to be sympatric with *M. balbus*, but it is easily distinguished by the presence of black spots on yellow flanks (vs unspotted on apricot in *M. balbus*) and its brighter yellow ventral surface (vs off-white in *M. balbus*). In addition, *M. fleayi* is a more slender, longer-legged species than *M. balbus*, and more closely resembles *M. fasciolatus* in general body form. The most likely confusion is between *M. fleayi* and *M. fasciolatus*, which are widely sympatric. The underparts of *M. fleayi* are yellow (white in *M. fasciolatus*), the pale stripe along the upper lip is interrupted, or non-existent, below the eye (continuous in adult *M. fasciolatus* but may be interrupted in juveniles) and the upper half of the iris is silvery white or even pale blue (black with minute traces of gold in adult *M. fasciolatus* but in juvenile upper half of iris is red). With practice the two are readily separated both by posture and colour. When undisturbed, *M. fleayi* tends to hold the body in a more vertical posture with the longer legs held further away from the more slender body and head than *M. fasciolatus*.

The calls most closely resemble those of *M. balbus* and are very different from the deep, throaty 'groop' of *M. iteratus* and the short 'wark' of *M. fasciolatus* and *M. schevilli*. The 'ok-ok-ok-ok' call resembles in quality the equivalent call of *M. balbus*, but differs in its shorter duration and much slower note repetition rate (cf. Barker and Grigg 1977).

NOMENCLATURE

We have examined the holotypes of *M. balbus* Straughan (1968) and *M. iteratus* Straughan (1968): AM R25922 and 25929 respectively. Neither is conspecific with *M. fleayi*. Straughan (*loc. cit.*) did not examine any type material of *M. fasciolatus* *schevilli* Loveridge (1933) or *M. fasciolatus* Günther (1864). We have examined a paratype of the former (QM J5443), which agrees in details with the holotype. It is a member of Straughan's taxon, *M. schevilli*.

The British Museum (Natural History) lent us one (BMNH 1947.2.19.89) of the two syntypes of *M. fasciolatus* Günther. The specimen is typical of the taxon we call *M. fasciolatus*. The lips are pale and no dark markings intrude; the hindlimbs are short (TL/SV = 53.5, HW/TL = 84.7). We select this specimen to be the lectotype of *Mixophyes fasciolatus* Günther (1864).

There is one other available name within the genus *Mixophyes*: *Hyla fenestrata* de Vis (1885a),

Boulenger (1885) noted that it was a *Mixophyes* and was scathingly critical of de Vis for his inability to tell the difference between the genera. The type material of *Hyla fenestrata* is presumably lost (Covacevich 1971). In the Queensland Museum, where de Vis worked, there are four old specimens (J10418-22) of *M. fasciolatus* from Tweed River — the type locality of *H. fenestrata*. These apparently are not types because none fits the measurements given in the type description. Further, de Vis (1885a,b) did not indicate if he had more than one example of the taxon. For these reasons, and because no date of collection has been recorded for the extant Tweed River specimens, there is no way of knowing whether or not they were seen by de Vis.

Straughan (1968), in his revision of *Mixophyes*, failed to deal with the problem of the availability of the name, *H. fenestrata*. Cogger *et al.* (1983) treated the name as a junior subjective synonym of *M. fasciolatus*. Their reasons for this action were not stated but we agree with the decision. De Vis's description of the characteristics of *H. fenestrata* matches the characteristics of *M. fasciolatus*. He said 'toes less than two thirds webbed', that 'lips pale minutely marbled with black', and that 'flanks white, spotted with black' (in preservative, the yellow would have bleached). Also, these characteristics together are not present in *M. balbus*, *M. iteratus*, *M. schevilli*, or our new species (see the foregoing section on identification).

There has been further confusion about some of the type material of *Mixophyes*. Covacevich (1971) noted problems with the type material of *M. balbus* and *M. iteratus* supposedly lodged in the Queensland Museum by Dr Ian Straughan. According to Straughan (1968), there were two paratypes of *M. iteratus* lodged in the Queensland Museum. Covacevich found two specimens of *M. iteratus* in Straughan's collection, but one — QM J18851 from Lynch's Creek, Kyogle — did not agree with the given locality of 'Tweed River, Mount Warning'. The other (now registered as QM J45796) had no accompanying data. Straughan (*loc. cit.*) also said there were thirteen paratypes of *M. balbus* in the Australian and Queensland Museums. There are six in the Australian Museum (Cogger, 1979). Logically, there should be seven paratypes in the Queensland Museum. Covacevich (*loc. cit.*) found ten unregistered specimens in a jar labelled 'New England sp. nov. *M. balbus*'. These specimens are now registered as J45785-45794. We have examined them and found that three (J45785-7)

are *M. fasciolatus* and the other seven (J45788-94) are *M. balbus*. These seven specimens may be the missing seven paratypes and have been labelled 'probable types' in the collection.

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AVIAN TYPE SPECIMENS IN THE QUEENSLAND MUSEUM

GLEN J. INGRAM
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ABSTRACT

From 1862 to 1985, type specimens of 122 taxa were lodged in the collection of birds of the Queensland Museum. Most of the types were a result of the works of Charles Walter de Vis. Between 1880 and 1905, he described as new 107 forms of living birds. The majority of these were collected either in Queensland by Kendall Broadbent, or in British New Guinea at the behest of Sir William MacGregor.

INTRODUCTION

Ingram (1986c) has chronicled the bird collections of the Queensland Museum for the period 1862 to 1985. The history of the types, or name-bearing specimens, is very much a history of the works of Charles Walter de Vis (*né* Devis). He was the Curator, and later the Director, of the museum from 1882 to 1905 (Mack 1956). During that period he described 104 species and subspecies of extant birds, as well as 46 species of fossil birds. The latter are not included in this paper. Before his appointment as Curator, de Vis had described two species and one subspecies of birds under his nom-de-plume, 'Thickthorn' (Ingram 1986b). There is no evidence that he brought the types of these taxa with him to the museum.

With very few exceptions, de Vis's new taxa of birds came from two sources: Kendall Broadbent, the zoological collector for the Queensland Museum from 1880 to 1893, and Sir William MacGregor, the Administrator, and later the Lieutenant Governor, of British New Guinea from 1888 to 1898. Most of the new taxa (85 in all) were described from the specimens collected at the behest of Sir William. MacGregor employed several collectors while he was in British New Guinea, but apparently from 1896 Signor A. Giulianetti was his sole collector (this can be discerned from Giulianetti's handwriting on the labels of the specimens). British New Guinea, later Papua, is now part of Papua New Guinea (PNG).

De Vis's papers on New Guinean birds pose problems of priority. The results of his examination of MacGregor's specimens were published in the 'Annual Report on British New Guinea' for the particular year. There are, however, many reprints and versions of these. The colonies of Queensland, Victoria, and New South

Wales, as well as Great Britain, all contributed to financing the colony of British New Guinea (Joyce 1971). Perforce, the 'Annual Report' by MacGregor was presented to each of the Parliaments (and sometimes both Houses) of each government. They were thus printed at different times. For purposes of priority of nomenclature, all the reports and their dates of publication had to be established, and that has been a difficult task. And there is a further complexity. De Vis did not regard parliamentary papers as publication. Several times during 1889, in the minutes of the board of trustees of the Queensland Museum, as well as in correspondence, he stressed that the 'Annual Reports' were not scientific publications and he emphasised the need to publish his results elsewhere. In this he was only occasionally successful. I am unsure whether I have found all the versions and reprints, but I am fairly certain I have located the earliest. In 'Literature Cited', these have been cross-referenced along with dates of publication.

In the list that follows, the taxa are sequenced in alphabetical order of the specific or subspecific epithets. Those in bold lettering have all, or at least some, of the name-bearing specimens in the collection. If the name is in standard type-face, no name-bearing specimens have been located, either because they have been lost or were not lodged here. The data given is that on the labels of the specimens. If the data is in inverted commas, the information is taken from the paper where the type description occurs. If the data is in square brackets, the information has been added by me and is justified where necessary. Other data added is accompanied by the appropriate references. The original spelling of the names of the taxa has been kept.

In 'Literature Cited', all publications that contain descriptions of new taxa are accompanied by the exact date of publication where possible. I have followed Colliver (1960) for the dates of publication for the *Transactions of the Queensland Philosophical Society* and the *Proceedings of the Royal Society of Queensland*; Fletcher (1896) for the early volumes of the *Proceedings of the Linnaean Society of New South Wales*; Ingram (1986a) for the *Annals of the Queensland Museum*; Mathews (1917) for the parts of Diggle's *Ornithology of Australia*; and Whittell (1954) in a few difficult cases. But mostly the date of publication was available on the paper itself.

Until 1911, the Queensland Museum had several numbering systems for retrieval of data. Numbers preceded by 'D', 'P', 'E', 'C', and 'T' stood for 'donor', 'purchase', 'exchange', 'collection', and 'transfer' respectively. These numbers could be found in the corresponding registers. There was also a general register with numbers prefixed by 'R'. Sometime in the 1880s, de Vis began a card index for birds as a separate system in which each specimen of a particular taxon received a unique letter (i.e., a, b, c, ... aa, bb, cc, etc). In 1911, all these systems were superceded by the modern bird register, where each specimen received a unique number preceded by 'O'. Contemporaneous with this system was the MacGregor register, which was used to register all kinds of material including ethnological items. These had a unique number preceded by 'M' or 'MAC'. Many of MacGregor's bird specimens had been registered there, and, unfortunately, not a few other birds of New Guinean or other origins. It was not until the end of 1985 that all ornithological material was finally registered under the 'O' numbering system.

In the following, 132 taxa are listed. Of these, there is evidence that the types for ten were never lodged in the museum. Of the remaining 122, no types could be located for 18 of the taxa.

LIST OF THE TYPE SPECIMENS

albicauda — *Rhipidura albicauda* de Vis, 1897.

Ibis, (7)3: 375. Holotype: O.20717. De Vis had no exact locality data for this spirit specimen from Papua, PNG. Presented by Sir William MacGregor.

The specimen has now been dried out from spirit and placed in the skin collection.

amabilis — *Ptilonopus amabilis* de Vis, 1880.

Queenslander, 7 August, p. 172. This was published under de Vis's nom-de-plume of 'Thickthorn' (see Ingram 1986b). He had a male bird that was collected in the Rockhampton district, CEQ. There is no evidence that the specimen was donated to the Queensland Museum.

animosa — *Climacteris animosa* de Vis, 1895.

Abs. Proc. Linn. Soc. N.S.W., Sept. 25, p.i. Syntypes: Male O.10289, Female, O.10290, Male, O.13237. Male, O.13238. Female, O.13239. Male, O.14864. All from Charleville, SCQ, Nov. [1885]. Collected by K. Broadbent.

The paper that was to describe this species was withdrawn and appeared in title only (de Vis 1896). Mathews (1934), however, considered the publication of the abstract (de Vis 1895c) to be an indication. There were originally ten specimens in the type series. Two males and two females (labelled 'a', 'f', 'i' and 'k') are missing. North (1906), however, noted that a female was sent in exchange to the Australian Museum. This specimen is now registered as AM O.782 (N.W. Longmore pers. comm.). De Vis (1895c) did not give the year of collection but Broadbent was in Charleville in 1885 (de Vis 1885).

armiti — *Paecilodryas armiti* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 101. Holotype: O.19765 (formerly M.6866, T.51), Mt Maneao, 5650 ft, PNG, April 1894. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

atropygialis — *Poephila atropygialis* Diggle, 1876.

Brisbane Courier, 5 Aug., p. 3. Holotype: This specimen has not been located. It was collected at Normanton, NWQ, by T.A. Gulliver. In an 1876 inventory of bird material held in the Queensland Museum, this specimen is listed. However, at that time, the birds (50 specimens) collected by Gulliver were not held in the museum but were at Charles Coxen's residence, along with various boxes of other skins (3 boxes in all). It seems that these specimens were incorporated into the museum's collection after Coxen's death (Gregory 1877).

auricularis — *Rhipidura auricularis* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 59. Holotype: Female, O.19746, Musgrave Range, 7000-9000 ft, PNG. Presented by Sir William MacGregor.

ballarae — *Amytornis textilis ballarae* Condon, 1969.

Mem. Qd Mus., 15: 205. Holotype: Female, O.10692, six miles south of Mary Kathleen, near Ballara Copper Mine, NWQ, 17 Jul. 1966. Collected by 'R.K. Carruthers'. Paratype: female, O.11011, Sybella Creek, Mt Isa, NWQ, 27 Oct. 1966. Collected by R.K. Carruthers.

belfordi — *Melirrhophetes belfordi* de Vis, 1890. *Vict. Parl. Pap.*, No. 21-(2S)-3598: 60. Holotype: Immature female, O.19801 (formerly M.6939), 'Mt. Knutsford', PNG. Collected by 'Mr. Belford'. Presented by Sir William MacGregor.

bella — *Charmosynopsis bella* de Vis, 1901. *Ann. Qd Mus.*, 5, pl. 8. Syntypes: [Immature], O.19531 (formerly M.6715, T.74). [Male], O.19415 (formerly M.6711, T.74). [Male], O.19471 (formerly M.7168). [Female], O.19470 (formerly M.6713, T.74). [Female], O.19472 (formerly M.6712, T.74). [Female], O.19473 (formerly M.6714, T.74). Collected at 'Wharton Range?', PNG. Presented by Sir William MacGregor.

bivittata — *Petroeca bivittata* de Vis, 1897. *Ibis*, (7)3: 376. Holotype: Female, O.19800 (formerly M.7297), Mt Scratchley, 12200 ft, PNG, 5 Oct. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

brevicauda — *Drymaedus brevicauda* de Vis, 1894. *Qd Parl. Pap.*, C.A. 93-1894: 103. Holotype: O.19840 (formerly M.6459, T.51), Mt Maneao, PNG. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

breviceps — *Melithreptus breviceps* de Vis, 1884. *Proc. R. Soc. Qd*, 1:159. This appears to be a slip of the pen for *M. brevirostris*, and that de Vis had no intention of introducing a new name for birds from New South Wales. *M. breviceps* is therefore a *nomen nudum*.

brevirostris — *Drymaedus brevirostris* de Vis, 1897.

Ibis, (7)3: 386. Holotype: Female, O.19753 (formerly M.7074, T.58). [Boirave], PNG, 9 Jul. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

De Vis gave no locality and none is on the original label. However, from de Vis's (1898b) report, and from the labels on the specimens, it

can be said that Giulianetti was collecting at Boirave at least from 7 to 24 July, 1896.

brisbanensis — *Cuculus brisbanensis* Diggles, 1876.

Brisbane Courier, 5 Aug., p. 3. Although the Queensland Museum purchased 'part' of Diggles' collection in 1876, there is no evidence that the holotype was amongst that collection. The specimen was collected at Norman's Creek, Brisbane, SEQ, in May 1876, by Diggles' son.

brunnea — *Gerygone brunnea* de Vis, 1897.

Ibis, (7)3: 378. Holotype: Not located. De Vis described this taxon from a spirit specimen from Papua, PNG. Presented by Sir William MacGregor.

candidior — *Arses candidior* Le Souef, 1897.

Ibis, (7)3: 397. Le Souef described the nest and eggs of 'Arses candidior De Vis, White-breasted Flycatcher'. De Vis, however, was not the author of this name. In a letter to North (1903), de Vis wrote: 'There is evidently some misconception about *Arses candidior*, arising doubtless from the presence of that name on the original cabinet label of *A. lorealis*. *Arses candidior* seems to have been given by Mr. K. Broadbent to an enquirer asking him the name of the bird; hence the idea that I have named two species of the genus'. Mathews (1930) said *A. candidior* was a nude name, but the name is valid. Le Souef must be regarded as the author of the name, and the eggs he described are the type specimens. These eggs are not in the Queensland Museum collection.

canescens — *Merula canescens* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 105. Syntypes: O.19742 (formerly M.7301, T.52). O.19743 (formerly M.6501, T.52). O.19744 (formerly M.7114, T.52). All from Goodenough Island, PNG. Presented by Sir William MacGregor.

caniceps — *Poecilodryas caniceps* de Vis, 1897.

Ibis, (7)3: 377. Holotype?: O.20703. De Vis had no exact locality data for this specimen from Papua, PNG. Presented by Sir William MacGregor.

De Vis gave no culmen measurement for this specimen which was in spirit. O.20703 fits all his measurements and has a damaged bill. It, however, was tied with another specimen (O.20704) in spirit. These have been dried out and are now in the skin collection.

cantator — *Pseudogerygone cantator* Weatherill, 1908.

Qd Nat., 1:74. Holotype: Male, O.12396, 'south-east Queensland'. Collected and presented by W.E. Weatherill.

capensis — *Sericornis magnirostris capensis* Mathews, 1941.

Emu, 40: 384. Holotype: Male, O.4125, Rocky Scrub, Cape York, NEQ, 13 Jul. 1938. Collected by G. Neuhauser ('Dr. G. Scott').

cardwelli — *Aegintha temporalis cardwelli* Mathews, 1942.

J. R. Soc. W.A., 27: 78. Holotype: O.15866 (formerly C.28), Cardwell, NEQ, Oct. 1888. Collected by K. Broadbent.

cervinus — *Acrocephalus cervinus* de Vis, 1897.

Ibis, (7)3: 386. Holotype: Female, O.19764 (formerly M.7076, T.58), [Boirave], PNG, 24 Jul. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

No locality was given but on 24 Jul. 1896, Giulianetti was at Boirave (see the entry for *Drymaoedus brevirostris*).

chillagoensis — *Aerodramus spodiopygius chillagoensis*, Pecotich, 1982.

Tower Karst Occasional Paper, 4: 56. Holotype: Female, O.18951. Paratypes: O.18948. Female, O.18949. O.18950. All specimens collected at Gordale Scar Pot Cave, Spring Tower, Chillagoe, NEQ, 29 Dec. 1981, by L. Wedgwood.

citrypura — *Pachycephala citrypura* de Vis, 1880.

Queenslander, July 31, p. 140. This name was published under de Vis's nom-de-plume of 'Thickthorn'. His description was taken from individuals of both sexes from the Rockhampton district, CEQ. There is no evidence that de Vis brought these specimens with him to the Queensland Museum.

colesi — *Trichoglossus colesi* Le Souef, 1910.

Emu, 10: 204. Holotype: Male, O.3604, Gladstone, MEQ, 8 Oct. ('Nov.') 1910. Collected by C. Coles.

collaris — *Melirrhophetes collaris*, de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 103. Syntypes: Male, O.19806 (formerly M.7015, T.51), Mt Maneao, 2700 ft, PNG, 18 Mar. 1894. Male,

O.19807 (formerly M.7016, T.51), Mt Maneao, 5000 ft, PNG, 4 Apr. 1894. O.19810 (formerly M.7019, T.51), Mt Maneao, 5000 ft, PNG, 4 Apr. 1894. Female, O.19811 (formerly M.7020, T.51), Mt Maneao, 5000 ft, PNG, 4 Apr. 1894. All collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

One specimen of unnoted sex from Mt Maneao, 5000 ft, is missing.

concinna — *Rhipidura concinna* de Vis, 1892.

Qd Parl. Pap., C.A. 1-1892: 94. Holotype: Male, O.19778 (formerly M.7109), Mt Suckling, 5651 ft. ('4350 ft'), PNG, 27 Jul. 1891. Presented by Sir William MacGregor.

cuicui — *Zosterops cuicui* de Vis, 1897.

Ibis, (7)3: 384. Syntypes: Male, O.19733 (formerly M.6861, T.58), 14 Jul. 1896 ('9 Jul.'). Female, O.19926 (formerly M.6862, T.58), 9 Jul. 1896 ('16 Jul.'). Both collected at Boirave, PNG, by 'A. Giulianetti'. Presented by Sir William MacGregor.

De Vis (1898b) used *Zosterops kuikui* for this taxon. This is also the name he wrote on the labels of the specimens. It is difficult to decide whether 'kuikui' is a justified emendation of 'cuicui'. There can be little doubt that the former was de Vis's preference. 'KUIKUI' was the native name of the bird as recorded by Giulianetti. In de Vis (1897b: 392), however, the editors of *Ibis* said that the author had given them full authority to amend his manuscript. Presumably, they objected to the neo-latin letter 'k' and corrected it to 'c'.

cuneata — *Geocichla cuneata* de Vis, 1889.

Proc. R. Soc. Qd, 6: 242. Lectotype: Male, O.14839. Paralectotype: female, O.14840. Both collected at Herberton Scrubs ('Herberton, 4500 ft') by 'K. Broadbent'.

Lectotype selected by Ford (1983). O.14839 is a male, not a female as stated by Ford. The second female from the original type series has not been located.

devisi — *Rhipidura devisi* North, 1897.

Proc. Linn. Soc. N.S.W., 22:444. Holotype: Same as for *Rhipidura albicauda* de Vis.

R. devisi is a replacement name for *R. albicauda* de Vis (1897b), which was preoccupied by the same name of North (1895).

discolor — *Colluricincla discolor* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 60.

Syntype: O.2808, Sudest Island, PNG, 8 Oct. 1888. Presented by Sir William MacGregor.

Two syntypes have not been located. O.2808 is erroneously registered as having been purchased from Kendall Broadbent. The handwriting and data on the label are the same as for the other specimens from Sudest Island from that batch of MacGregor's. The error has happened before. Two other specimens of MacGregor's (O.255-6) were erroneously registered as Broadbent's.

divaga — *Monarcha divaga* de Vis, 1897.

Ibis, (7)3: 374. Holotype: Female, O.19796 (formerly M.6908, T.58), Boirave, PNG, 14 Jul. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

ferocyanea — *Myiagra ferocyanea* Ramsay, 1879.

Nature, 20: 125. Syntype?: [Male], O.20855, no data on label. N.W. Longmore (pers. comm.) notes that Ramsay sent a syntype (Australian Museum A.3834) to the Queensland Museum in 1883 as part of an exchange. The specimen (a male) was collected on Guadalcanar, Solomon Islands by Captain Brodie and J.F. Cockerell in Dec. 1878 (also see Ramsay, 1879b). An old mounted specimen, O.20855, is most likely the syntype. W. Boles (pers. comm.) says the specimen is *Myiagra ferocyanea* and is comparable to the other syntypes in the Australian Museum. Ramsay (1879b) emended the name to *ferocyanea*.

flavigaster — *Acanthiza flavigaster* Diggles, 1876.

Brisbane Courier, 5 Aug., p. 3. Syntypes: These specimens have not been located. Three were collected at Normanton, NWQ, by T.A. Gulliver — the inventory of 1876 listed two skins and one duplicate (see the entry for *Poephila atropygialis*). Diggles also had another specimen that was collected at Norman's Creek, Brisbane, SEQ, by his son. The fate of this specimen is also unknown.

fretorum — *Pachycephala fretorum* de Vis, 1889.

Proc. R. Soc. Qd., 6: 237. Syntype: Female, O.14843, Kimberley, NWQ, Jul. 1884. Collected by K. Broadbent.

Three syntypes were not located: a female collected at Cambridge Gulf, WA (the type

status of this specimen has been questioned by Mees, 1964); and two males collected at Kimberley, NWQ. There is an old mount with no data in the collection (male, O.21567) that may be one of the missing types.

fuliginosa — *Oreospiza fuliginosa* de Vis, 1897.

Ibis, (7)3: 388. Syntypes: Female, O.18963 (formerly M.6432), 20 Sep. 1896. Male, O.18965 (formerly M.6434), 17 Sep. 1896. Female, O.18968 (formerly M.6437), 28 Sep. 1896. Female ?, O.19720 (formerly M.6429), 2 Oct. 1896. All collected at Mt Scratchley, 12200 ft, PNG, by 'A. Giulianetti'. Presented by Sir William MacGregor.

fuliginosus — *Circus fuliginosus* Diggles, 1875.

Brisbane Courier, 8 May, p. 7. There is no evidence that the type material was donated to the museum. Unlike the other Cockerell material that Diggles described, however, the holotype is not in the British Museum of Natural History (Warren, 1966; M. Walters, *in litt.*). Diggles's description was taken from a specimen collected at the Nudgee Waterholes, SEQ, on 25 Mar. 1871, by J.T. Cockerell.

fusca — *Acanthochoera fusca* de Vis, 1897.

Ibis, (7)3: 383. Syntypes: Female, O.19754 (formerly M.6993), 2 Oct. 1896. Male, O.19755 (formerly M.6989), 29 Sept. 1896. Female, O.19756 (formerly M.6991), 3 Oct. 1896. Male, O.19757 (formerly M.6990), 6 Oct. 1896. Male, O.19759 (formerly M.6996), 28 Sep. 1896. Female, O.19760 (formerly M.6994), 2 Oct. 1896. Male, O.19761 (formerly M.6992), 25 Sep. 1896. All specimens were collected at Mt Scratchley, 12200 ft, PNG, by 'A. Giulianetti'. Presented by Sir William MacGregor.

Three spirit specimens have not been located.

goodenoviensis — *Ninox goodenoviensis* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 58. Syntypes: Male, O.17193. Female, O.19271. Both from Goodenough Island, PNG. Presented by Sir William MacGregor.

griseiceps — *Sittella griseiceps* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 102. Holotype: Male, O.19775 (formerly M.7081, T.51), Mt Maneao, 5650 ft, PNG, Apr. 1894. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

griseiceps — *Micraea griseiceps* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 101. Holotype: Male, O.19772 (formerly M.6904, T.51), Mt Maneao, 1400 ft, PNG, 17 Mar. 1894. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

guisei — *Ptilotis guisei* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 103. Syntypes: O.19747 (formerly M.7021, T.51), Apr. 1894. Male, O.19748 (formerly M.7004, T.51), 22 Apr. 1894. Female, O.19749 (formerly M.7023, T.51), 23 Apr. 1894. Female, O.19750 (formerly M.7022, T.51), 21 Apr. 1894 ('23 Apr.'). All collected at Mt Maneao, 5650 ft, by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

gutturalis — *Anthus gutturalis* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 103. Syntypes: Male, O.19727 (formerly T.51), 6000 ft. Female, O.19728 (formerly M.6487, T.51), 6000 ft. Male, O.19729 (formerly M.6488, T.51), 6000 ft. Male, O.19730 (formerly M.6489, T.51), 6000 ft. Female, O.19731 (formerly M.6486, T.51), 5650 ft. All collected at Mt Maneao, PNG, Apr. 1894, by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

gutturalis — *Sericornis gutturalis* de Vis, 1889.

Proc. R. Soc. Qd., 6: 242. Syntypes: Female, O.12131, Herberton ('Herberton Scrubs, 4500 ft'), NEQ, May 1889. Male, O.12127 (formerly C.64), North Peak, Bellenden Ker, 5760 ft, NEQ, Jun. 1889. Both collected by K. Broadbent.

halli — *Pomatostomus halli* Cowles, 1964.

Emu, 64: 1. Holotype: Male, O.9962, Tyrone Homestead, 3 miles E of Langlo Crossing, SCQ, 15 May 1963. Collected by P.R. Colston. Presented by the British Museum (Natural History).

helenae — *Parotia helenae* de Vis, 1897.

Ibis, (7)3: 390. Syntypes: Male, O.19684 (formerly M.6545), 3 Nov. 1896. Male, O.19685 (formerly M.6546), 3 Nov. 1896. Male, O.19686 (formerly M.6547), 4 Nov. 1896. All collected at Neneba, Mt Scratchley, by 'A. Giulianetti'. [Female], O.20698. Presented by Sir William MacGregor.

One male and one female are missing.

hindwoodi — *Meliphaga hindwoodi* Longmore and Boles, 1983

Emu, 83: 59. Holotype: Male, O.17574, Massey Creek, Clarke Range, MEQ, 7 Dec. 1894. Collected by the Mid-eastern Queensland Expedition 1978. Paratypes: female, O.17530, 1 Dec. 1978. Male, O.17543, 2 Dec. 1978. Female, O.17544, 2 Dec. 1978. Male, O.17545, 2 Dec. 1978. Male, O.17548, 2 Dec. 1978. Male, O.17550, 2 Dec. 1978. Male, O.17551, 2 Dec. 1978. Female, O.17562, 3 Dec. 1978. Male, O.17547, 2 Dec. 1978. Female, O.17580, 8 Dec. 1978. All collected at Massey Creek, 18 km NE Dalrymple Heights, MEQ, by the Mid-eastern Queensland Expedition 1978. The people of this expedition were N.W. Longmore, W.E. Boles, T.R. Lindsey, J.M. Shields, A. Lindsey, and G.J. Ingram.

Five paratypes (O.17494, 17511, 17552, 17566-7) are now in the Australian Museum.

humeralis — *Ibis (Falcinellus) humeralis* de Vis, 1898.

Vict. Parl. Pap., No. 23-5027: 90. Holotype?: O.17863 (formerly M.7218), 'Laloki River, PNG'. Presented by Sir William MacGregor.

Although O.17863 has no data, it is the only specimen in the MacGregor collection of a Glossy Ibis and it fits de Vis's description.

insignissimus — *Aprosmictus insignissimus* Gould, 1874.

Proc. Zool. Soc. Lond., 1874: 500. Holotype: O.3437, near ('a few miles north') Dalby, SCQ. Presented by C. Coxen. This specimen can not be located. In the register there is a note that the specimen was on display in 'Exhibition case' and Chisholm (1922) said the mount could be seen on display. Nothing else is known of the specimen. Gould (1875, pl. 9) had an illustration of the holotype.

insperata — *Gerygone insperata* de Vis, 1892.

Qd Parl. Pap., C.A. 1-1892: 94. Holotype: O.19777 (formerly M.7118), Mt Suckling, 6000-7000 ft, PNG, 'Jul. 1891'. Presented by Sir William MacGregor.

intermedia — *Climacteris leucophaea intermedia* Boles and Longmore, 1983.

Emu, 83: 272. Holotype: Male, O.18019 (formerly Australian Museum O.53758), Timber Reserve 679, Clarke Range, MEQ, 6 May 1980. Collected by N.W. Longmore and W.E. Boles. Paratype: female, O.17559, Massey

Creek, 18 km NE Dalrymple Heights, MEQ, 3 Dec. 1978. Collected by Mid-eastern Queensland Expedition 1978 (see *Meliphaga hindwoodi*).

intermedia — *Paradisea intermedia* de Vis, 1894. *Qd. Parl. Pap.*, C.A. 93-1894: 105. Syntypes: Male, O.19460 (formerly M.6624, T.52). Male, O.19462 (formerly M.6629, T.52). Both specimens collected at Coomassie ('Kumusi') River, PNG, Apr. 1894 by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

One male syntype has not been located.

joanae — *Ailuroedus melanotis joanae* Mathews, 1941.

Emu, 40: 384. Holotype: Male, O.4124, Rocky Scrub, Cape York, NEQ, 23 Jun. 1938. Collected by G. Neuhauser ('Dr. G. Scott').

katherina — *Acanthiza katherina* de Vis, 1905. *Ann. Qd. Mus.*, 6: 43. Syntypes: Female, O.12100. Male, O.12101 (formerly C.64). Female, O.12102. Male, O.12103. All collected at Bellenden Ker, 4000 ft, NEQ, Jul. 1889 by K. Broadbent.

keasti — *Rhipidura fuliginosa keasti* Ford, 1981. *Emu*, 81: 129. Holotype: Male, O.17522, Massey Creek, 18km NE of Dalrymple Heights, MEQ, 1 Dec. 1978. Collected by the Mid-eastern Queensland Expedition 1978 (see *Meliphaga hindwoodi*).

kowaldi — *Todopsis kowaldi* de Vis, 1890. *Vict. Parl. Pap.*, No. 21-(2S)-3598: 59. Holotype: This male specimen from Papua, PNG, has not been located. Presented by Sir William MacGregor. De Vis (1894a) noted that the specimen was an adult and not a young bird as he had originally thought.

lacrimans — *Ptilotus lacrimans* de Vis, 1897. *Ibis*, (7)3: 382. Syntypes: Female, O.19797 (formerly M.6834), 5 Oct. 1896. Female, O.19798 (formerly M.6833), 16 Sep. 1896. Both collected at Mt Scratchley, 12200 ft, PNG, by 'A. Giulianetti'. Presented by Sir William MacGregor.

laeta — *Alcyon laeta* de Vis, 1894. *Qd. Parl. Pap.*, C.A. 93-1894: 100. Syntypes: O.19351 (formerly M.6362, T.51). O.19352 (formerly M.6359, T.51). Both collected at Mt

Maneao, PNG, by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

laeta — *Zosterops laeta* de Vis, 1897.

Ibis, (7)3: 385. Syntypes: These two spirit specimens from Papua, PNG, have not been located. Presented by Sir William MacGregor.

laetiscapa — *Rhipidura laetiscapa* de Vis, 1898. *Vict. Parl. Pap.*, No. 23-5027: 83. Syntypes: Female, O.19779 (formerly M.6836, T.68). Wharton Range, 11100 ft, Jul. 1897. Male, O.19780 (formerly M.6837, T.68), Wharton Range, '11100 ft', PNG, Jul. 1897. Both collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

leucypura — *Gerygone albogularis leucypura* de Vis, 1880.

Queenslander, May 22, p. 650. This name was published under de Vis's nom-de-plume of 'Thickthorn'. The name is based on observations, or specimens from Rockhampton, CEQ. If there were specimens, there is no evidence they were donated to the Queensland Museum.

longicauda — *Graucalus longicauda* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 59. Holotype?: [Male], O.20437, 'Musgrave Range, 7000-9000 ft', PNG.

De Vis's description of the holotype fits this specimen, which is labelled '*Graucalus longicauda* de Vis' in his hand, but with no other data. Presented by Sir William MacGregor.

loralis — *Poecilodryas loralis* de Vis, 1897.

Ibis, (7)3: 377. Syntypes: O.20706, O.20707. De Vis had no exact locality data for these two spirit specimens from Papua, PNG. Presented by Sir William MacGregor.

The specimens have been dried out and are now in the skin collection.

lorealis — *Arses lorealis* de Vis, 1895.

Abs. Proc. Linn. Soc. N.S.W., Apr. 24, p.i. Syntypes: Male, O.3697. Female, O.3698. Both collected at Cape York, NEQ, 'Mar. 1894' by K. Broadbent.

Mathews (1934) noted that the prepublished abstract (de Vis, 1895a) predated the intended description (de Vis 1895b).

lurida — *Ninox boobook lurida* de Vis, 1887.

Proc. Linn. Soc. N.S.W., (2)1: 1135. Syntypes: 'Male' O.14841, Maunga Creek, 8 miles from Cardwell, NEQ, 14 May 1886. 'Male', O.14842, Herbert Gorge, NEQ, 11 May 1886. Both collected by K. Broadbent.

De Vis (1889f) detailed '*N. lurida* n.s.' This was not a new name, but an elevation of *Ninox boobook* var. *lurida* to the rank of species.

macgregoria — *Maria macgregoria* Sclater and Saunders, 1897.

Ibis, 7(3): 251. Syntypes: Same as for *Macgregoria pulchra* de Vis.

This name was introduced into the literature by the editors of *Ibis* in an editorial comment to de Vis's (1897a) description of *Macgregoria pulchra*.

macgregoriae — *Amblyornis macgregoriae* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 60. Syntype: [Female], O.19432, Musgrave Range, '7000-9000 ft', PNG. Presented by Sir William MacGregor.

Two females and two males from the original type series have not been located.

macgregorii — *Cnemophilus macgregorii* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 61. Holotype: Male, O.19429, Mt Knutsford, '11000 ft', PNG. Presented by Sir William MacGregor.

maculata — *Melipotes maculata* de Vis, 1892.

Qd Parl. Pap., C.A. 1-1892: 94. Holotype: Female, O.19774 (formerly M.7151), Mt Suckling, '6000-7000 ft', PNG, 'Jul.' 1891. Presented by Sir William MacGregor.

maculiceps — *Sarganura maculiceps* de Vis, 1898.

Vict. Parl. Pap., No. 23-5027: 87. Holotype: Male, O.19841 (formerly M.6885, T.68), Wharton Range, PNG, Jul. 1897. Collected by [A. Giulianetii]. Presented by Sir William MacGregor.

manayoensis — *Rhipidura manayoensis* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 101. Holotype: O.19784 (formerly M.6846, T.51), Mt Maneao, PNG. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

mariae — *Cnemophilus mariae* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 104. Syntypes: Male, O.19714 (formerly M.6662, T.51), 5650 ft. [Female], O.19715 (formerly M.6661, T.51), '5000 ft'. [Female], O.19716 (formerly M.6654, T.51), '5000 ft'. Male, O.19717 (formerly M.6658, T.51), '5000 ft'. Female, O.19718 (formerly M.6660, T.51), '5000 ft'. Female, O.19719 (formerly M.6655, T.51), 5000 ft. All collected at Mt Maneao, PNG, Apr. 1894 by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

One female syntype has not been located.

mcgilli — *Acanthiza pusilla mcgilli* Boles, 1983.

Emu, 83: 55. Holotype: Male, O.18688, (formerly Australian Museum O.53765), Massey Creek, Clarke Range, MEQ, (21°04'S, 148°35'E), 1 May 1980. Collected by Australian Museum party. Paratypes: male, O.6222, Broken River, Eungella Range, MEQ, 7 Aug. 1958. Collected by S. Breeden. Male, O.15956, Crediton, Clarke Range, MEQ, 18 Apr. 1975. Collected by D.P. Vernon. Female, O.17529, Massey Creek, 18 km NE Dalrymple Heights, MEQ, 1 Dec. 1978. Collected by the Mid-eastern Queensland Expedition 1978. Female, O.17561, Massey Creek, 18 km NE Dalrymple Heights, MEQ, 4 Dec. 1978. Collected by the Mid-eastern Queensland Expedition 1978. Female, O.17572, Timber Reserve 679, Dalrymple Heights, MEQ, 7 Dec. 1978. Collected by the Mid-eastern Queensland Expedition 1978. Male, O.17573, Timber Reserve 679, Dalrymple Heights, MEQ, 7 Dec. 1978. Collected by the Mid-eastern Queensland Expedition 1978 (see *Meliphaga hindwoodi*).

Five paratypes (O.17569, 17571, 17570, and 18688) are now in the Australian Museum. According to Appendix D iii 21(a) of the 1985 edition of *International Code of Zoological Nomenclature*, *mcgilli* should be amended to *macgilli*.

mestoni — *Corymbicola mestoni* de Vis, 1889.

Queenslander, March 30, p. 600. Holotype: 'Male', O.15313, Mt Bartle Frere ('south peak of Bellenden-Ker, 5000 ft'), NEQ. Collected and presented by A. Meston.

Meston (1889) gave the altitude as 4800 ft. Barnard, who was with Meston, said the height was a little over 3000 ft and that the date of collection was at the end of January, 1889 (Chaffer 1984). There is some doubt as to whether de Vis intended to publish this

description. Chisholm and Chaffer (1956), however, argued that this was his intention.

mestoni — *Pachycephala mestoni* de Vis, 1905.
Ann. Qd. Mus., 6: 44. Holotype: Female, O.14849, spurs of Mt Sophia, Bellenden Ker, NEQ, Jun. 1889. Collected and presented by 'A. Meston'.

The label says the collector was Kendall Broadbent. This is an error.

minor — *Peltops minor* de Vis, 1894.
Qd Parl. Pap., C.A. 93-1894: 100. Syntypes: O.4355 and O.19794. Both from New Guinea, 20 May 1888.

De Vis had one other specimen from sea level at Mt Maneao, PNG, collected on 3 March and presented by McGregor. No specimen with this data has been located. But amongst the specimens on which de Vis (1894a) based his paper is a specimen (O.19793) from Mt Maneao at 700 ft collected on 7 March 1894. His 'specimen' and O.19793 (formerly M.6818, T.51) would have been received in the same lot (Transfer 51) from MacGregor. It is difficult to imagine that he would not have included it in the paper, for it is similar to O.19794 and O.4355. Certainly the three specimens have 'minor' written on each label in his handwriting with 'blainvillei' crossed out. It is possible that O.19793 was the specimen he had and that the data given in the paper is wrong.

miranda — *Daphoenositta miranda* de Vis, 1897.
Ibis, (7)3: 380. Syntypes: Female, O.19725 (formerly M.6923). Female, O.19726 (formerly M.6924). Both collected at Mt Scratchley, 12200 ft, PNG, 5 Oct. 1896, by 'A. Giulianetti'. Presented by Sir William MacGregor.

De Vis had four specimens. One in spirit cannot be located. The other syntype is in the British Museum (Natural History) registered as BMNH 1898.10.10.3 (Warren and Harrison 1971).

modesta — *Acanthiza modesta* de Vis, 1905.
Ann. Qd Mus., 6:43. Syntypes: Male, O.12113. Female, O.12114. Both collected at Charleville, SWQ, Oct. 1885, by K. Broadbent.

modesta — *Lamprococcyx modesta* Diggles, 1876.

Brisbane Courier, 5 Aug., p. 3. There is no evidence that the holotype was part of the collection purchased from Diggles in 1876 by the

museum. The specimen was 'shot with a boy's catapult' at Norman's Creek, near Captain Heath's, Brisbane, SEQ.

modesta — *Paecilodryas modesta* de Vis, 1894.
Qd Parl. Pap., C.A. 93-1894: 101. Holotype: Female, O.19785 (formerly M.6868, T.51), Mt Maneao, 5000 ft, PNG, 5 Apr. 1894. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

montana — *Crateroscelis montana* de Vis, 1897.
Ibis, (7)3: 387. Holotype: This specimen from Papua, PNG, which was a fledgeling stored in spirit, has not been located. It was presented by Sir William MacGregor. This name was suppressed under the plenary powers of the I.C.Z.N. (1963) for the purposes of priority but not for homonymy, after a submission by Mayr (1962). Mayr claimed the species was unidentifiable and that the type was lost. He gave no evidence to support either claim. Certainly his assertions were awry for two other of de Vis's names also suppressed as a result of his submission (see *Sericornis tyrannula* and *Meliornis schistacea*).

monticola — *Munia monticola* de Vis, 1897.
Ibis, (7)3: 387. Syntypes: Male, O.19788 (formerly M.6448), 1 Oct. 1896 ('16-28 Sep. 1896'). Female, O.19789 (formerly M.6446), 28 Sep. 1896. Female, O.19790 (formerly M.6447), 17 Sep. 1896. Female, O.19791 (formerly M.6443), 16 Sep. 1896. [Male], O.19792 (formerly M.6449, T.58). All collected at Mt Scratchley, 12200 ft, PNG, by 'A. Giulianetti'. Presented by Sir William MacGregor.

O.19792 does not have a date of collection or an altitude but it was part of the same batch (Transfer 58) from MacGregor. One syntype, said to be in spirit, cannot be located.

montium — *Paramythia montium* de Vis, 1892.
Qd Parl. Pap., C.A. 1-1892: 95. Holotype: Female, O.19741 (formerly M.7298), 'Disappointment Rock', Mt Suckling, 6900 ft, PNG, '28 Jul. 1891'. Presented by Sir William MacGregor.

moretoni — *Malurus moretoni* de Vis, 1892.
Qd Parl. Pap., C.A. 1-1892: 97. Holotype: Male, O.19963 (formerly M.7119), Bartle Bay, PNG, 25 Jun. 1891 ('15 Jun'). Presented by Sir William MacGregor.

murina — *Gerygone murina* de Vis, 1897.

Ibis, (7)3: 377. Syntype: Male, O.19786 (formerly M.6896), Mt Scratchley, 12200 ft, PNG, 6 Oct. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

The other syntype, which was registered as M.6895 (female) from Mt Scratchley, 12200 ft, has not been located.

nanus — *Cyclopsittacus nanus* de Vis, 1898.

Vict. Parl. Pap., No. 23-5027: 81. Holotype: O.19534 (formerly M.6743, T.68) 'Wharton Range (?)', PNG. Presented by Sir William MacGregor.

newtoniana — *Prionodura newtoniana* de Vis, 1883.

Proc. Linn. Soc. N.S.W., (1)7: 562. Holotype: In 1888, the Queensland Museum was broken into and this specimen was stolen while on display (de Vis, 1889h). It was a young male, collected at Tully River Scrubs, NEQ, Sep. 1882, by K. Broadbent (Campbell, 1901; Broadbent, 1902).

nigrifrons — *Rhipidura nigrifrons* de Vis, 1897.

Ibis, (7)3: 374. Holotype: Male, O.19781, (formerly M.6871), [Boirave], PNG, 24 Jul. 1896 ('7 Jul.'). Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

No locality was given but on 24 and 7 July, 1896, Giulianetti was at Boirave (see the entry for *Drymaeodes brevirostris*).

nigripectus — *Symmorphus nigripectus* de Vis, 1894.

Qd Parl. Pap., 93-1894: 102. Holotype: Male, O.19842 (formerly M.7068, T.51), Mt Maneao, PNG. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

nigropectus — *Eulucestoma nigropectus* de Vis, 1894.

Qd Parl. Pap., 93-1894: 102. Holotype: Male, O.19763 (formerly M.6426, T.51), Mt Maneao, 5650 ft, PNG, 22 Apr. 1894. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

nitida — *Poecilodryas nitida* de Vis, 1897.

Ibis, (7)3: 376. Holotype: Female, O.19927 (formerly M.6865), Boirave, PNG, 14 Jul. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

obscura — *Ptilotis obscura* de Vis, 1897.

Ibis, (7)3: 383. Holotype: This specimen has not been located. It was collected at Mt. Scratchley, PNG by A. Giulianetti and presented by Sir William MacGregor. De Vis noted that it was in bad condition.

oreas — *Rhipidura oreas* de Vis, 1897.

Ibis, (7)3: 375. Holotype: This spirit specimen from Papua, PNG, has not been located. Presented by Sir William MacGregor.

orientalis — *Nasiterna orientalis* de Vis, 1898.

Vict. Parl. Pap., No. 23-5027: 81. Syntype: O.19566 (formerly M.7165), 'Wharton Range (?)', PNG. Presented by Sir William MacGregor.

The other syntype (spirit specimen from Vanapa Valley, PNG, Mar. 1897) has not been located.

orientalis — *Ptilopus bellus orientalis* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 104. Syntypes: Male, O.19202 (formerly T.51), Mt Maneao, 3450 ft, PNG, 19 Mar. 1894. Presented by Sir William MacGregor. [Male], O.19201, inland of Port Moresby, PNG. Collected by Captain A. Musgrave.

ornatus — *Melirrhophetes ornatus* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 103. Syntypes: Female, O.19812 (formerly M.6982, T.51), Mt Maneao, 3000 ft, PNG, 7 Apr. 1894. O.19813 (formerly M.6984, T.51), Mt Maneao, '3000 ft', PNG, 19 Mar. 1894. 'Female', O.19814 (formerly M.7003, T.51), Mt Maneao, '5000 ft' PNG, 'Apr., 1894'. All collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

pallida — *Micraeca pallida* de Vis, 1884.

Proc. R. Soc. Qd, 1: 159. Syntypes: Male, O.14844. Female, O.14845. Female, O.14846. Female, O.14847. All collected at Kimberley, NWQ, Jul, 1884, by K. Broadbent.

pallidipes — *Zosterops pallidipes* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 60. Holotype: Male, O.19737 (formerly M.7112), Rossel Island, PNG. Presented by Sir William MacGregor.

papuensis — *Acanthiza papuensis* de Vis, 1894.

Qd Parl. Pap., C.A. 93-1894: 102. Holotype:

Male, O.19736 (formerly M.6438), Mt Maneao, 5650 ft, PNG, Apr. 1894. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

papuensis — *Merula papuensis* de Vis, 1890.
Vict. Parl. Pap., No. 21-(2S)-3598: 60. Syntype?: O.19762 (formerly M.7113), 'Mt Victoria', PNG. Presented by Sir William MacGregor

This specimen is without data but it agrees with de Vis's description. On the label is written 'Merula papuensis de Vis' in his hand. If it is a syntype, there is still one subadult specimen missing. Iredale (1956, p. 4, pl. 23) apparently examined both of these syntypes. Unfortunately, his usage of the word 'types' was ambiguous in this work. Sometimes he meant 'type specimens' and sometimes he meant 'kinds'. What he meant in his section on thrushes is uncertain.

perstriata — *Ptilotus perstriata* de Vis, 1898.
Vict. Parl. Pap., No. 23-5027: 86. Holotype: Female ('male'), O.19948 (formerly M.6835, T.68), Wharton Range, PNG, Jul. 1897. Collected by [A. Giulianetti]. Presented by Sir William MacGregor.

phasiana — *Rhipidura phasiana* de Vis, 1884.
Proc. R. Soc. Qd, 1: 158. Holotype: O.14848, Kimberley, NWQ, [Jul. 1884]. Collected by K. Broadbent.

piperata — *Ptilotus piperata* de Vis, 1898.
Vict. Parl. Pap., No. 23-5027: 86. Holotype: O.19787 (formerly M.7152), Suku, Vanapa, PNG, 1897. Presented by Sir William MacGregor.

prasina — *Neneba prasina* de Vis, 1897.
Ibis, (7)3: 384. Holotype: Male, O.19799, (formerly M.6884), Neneba, Mt Scratchley, 4000 ft, PNG, 9 Nov. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

pulchra — *Macgregoria pulchra* de Vis, 1897.
Ibis, (7)3: 251. Syntypes: Male, O.19724 (formerly M.6638, T.58), Mt Scratchley, 11000 ft, ('21000 ft'), PNG, 6 Sep. 1896 ('May 1896'). [Male], O.19723 (formerly M.6640, T.58), Mt Scratchley, 12200 ft ('21,000 ft'), ('May 1896') PNG. Both collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

De Vis's data was wrong: Mt Scratchley is not higher than 13000 ft and MacGregor ascended the mountain in September 1896 (MacGregor, 1898: 9). The third syntype is in the British Museum of Natural History (BMNH 1897.8.16.1). This is the specimen illustrated in de Vis (1897a, pl. 7). Warren and Harrison (1971) said there was another syntype in the BMNH but M. Walters (*in litt.*) could not locate any specimen that was immediately recognizable as a second syntype. There was one old specimen, however, which had been a mount, but had no data. Sharpe (1906) listed only one specimen of *M. pulchra* as having been received from the Queensland Museum.

punctata — *Micraeca punctata* de Vis, 1894.
Qd Parl. Pap., C.A. 93-1894: 101. Syntypes: Male, O.19734 (formerly M.6903, T.51). Male, O.19735 (formerly M.6902, T.51). Both collected at Mt Maneao, 5000 ft, PNG, Apr. 1894. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

punctatus — *Megalurus punctatus* de Vis, 1897.
Ibis, (7)3: 385. Holotype: Male, O.19773 (formerly M.7075), Neneba, Mt Scratchley, 4000 ft, PNG, 10 Nov. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

rawnsleyi — *Ptilonorhynchus rawnsleyi* Diggles, 1867.

Ornithology of Australia, Part XV, pl. 3. Chisholm (1965) stated that the holotype was in the Queensland Museum but had been lost. He implied that his information came from Iredale (1950), but Iredale did not mention the museum. In fact, there is no evidence the holotype was ever in that institution. The specimen was collected by H.C. Rawnsley at Witton, Brisbane, on 14 July, 1867. Rawnsley lent the specimen to John Gould who illustrated it (Gould, 1869, pl. 34). Marks (1965) cited a letter from Diggles to G. Masters in 1873 where Diggles said he thought the specimen was in the possession of Rawnsley's widow. Ramsay (1875) wrote of the specimen but he did not indicate who owned it or where he examined it. Except for this information, nothing is known of the specimen.

richardsi — *Ptilopus richardsi* Ramsay, 1882.
Proc. Linn. Soc. N.S.W., (1)6: 722. Syntypes: Female, O.20827 (formerly Australian Museum

A.11565). O.20828 (formerly Australian Museum A.11568). Both collected on Ugi, Solomon Islands, by A. Morton, in 1881.

N.W. Longmore (pers. comm.) notes that Ramsay sent these syntypes to the Queensland Museum in 1883 as part of an exchange.

robusta — *Gerygone robusta* de Vis, 1898.

Vict. Parl. Pap., No. 23-5027: 84. Syntypes: Male, O.19782 (formerly M.6826, T.68). Female, O.19932 (formerly A.6827, T.68). Both collected at Wharton Range, 11,100 ft, PNG, by [A. Giulianetti]. Presented by Sir William MacGregor.

rosaalba — *Strepera rosalba* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 59. Holotype: Female, O.19732 (formerly M.7156), Sudest Island, PNG, 8 Oct. 1888. Presented by Sir William MacGregor.

rufescens — *Cracticus rufescens* de Vis, 1883.

Proc. Linn. Soc. N.S.W., (1)7: 562. Syntypes: These specimens have not been located. The syntypes were collected at Tully and Murray Scrubs, NEQ, 1882, by K. Broadbent. De Vis did not say how many specimens he had, but there were at least one male and one female.

schistacea — *Meliornis schistacea* de Vis, 1897.

Ibis, (7)3: 381. Holotype: O.19745 (formerly M.7813). De Vis had no exact locality data for this specimen from Papua, PNG. Presented by Sir William MacGregor.

The I.C.Z.N. (1963) suppressed *Meliornis schistacea* for the purposes of priority but not homonymy after a submission by Mayr (1962). Mayr's submission was based on the grounds that the type was of uncertain identity and was apparently lost. Schodde (1978) pointed out that the type was in existence and that the suppression of the name was pointless.

sclateriana — *Amalocichla sclateriana* de Vis, 1892.

Qd Parl. Pap., C.A. 1-1892: 95. Holotype: O.19795, Mt Owen Stanley, PNG, 1892. Presented by Sir William MacGregor.

sibila — *Colluricincla sibila* de Vis, 1889.

Proc. R. Soc. Qd, 5:161. Holotype: This specimen has not been located. It was collected at Herbert Vale, over the range behind Cardwell, NEQ, by K. Broadbent. Apparently two examples were seen but only one collected.

sibisibina — *Ptilotus sibisibina* de Vis, 1897.

Ibis, (7)3: 381. Syntypes: Male, O.19802 (formerly M.6974, T.58), 13 Jul. 1896. Female?, O.19803 (formerly M.6975, T.58), 14 Jul. 1896. Female, O.19804 (formerly M.6976, T.58), 14 Jul. 1896. Male, O.19805 (formerly M.6973, T.58), 24 Jul. 1896. All collected at Boirave, PNG, by 'A. Giulianetti'. Presented by Sir William MacGregor.

sigillata — *Paecilodryas sigillata* de Vis, 1890.

Vict. Parl. Pap., No. 21-(2S)-3598: 59. Syntype: Immature, O.19752, Mt Victoria, 13000 ft, PNG. Presented by Sir William MacGregor.

De Vis had one other specimen, an adult. O.19751 matches his description but the specimen has no locality data.

sigillifer — *Lobospingus sigillifer* de Vis, 1897.

Ibis, (7)3: 389. Holotype: This spirit specimen from Papua, PNG, has not been located. Presented by Sir William MacGregor.

sororcula — *Pachycephala sororcula* de Vis, 1897.

Ibis, (7)3: 380. Holotype: 'Male', O.20705. De Vis had no exact locality data for this specimen from Papua, PNG. Presented by Sir William MacGregor.

This spirit specimen has been dried out and is now in the skin collection.

squamata — *Acanthiza squamata* de Vis, 1889.

Proc. R. Soc. Qd, 6: 248. Syntype: Male, O.12075 (formerly C.63). Female, O.12076 (formerly C.63). Both collected at Herberton, NEQ, May 1889 by K. Broadbent.

The other male syntype was exchanged with G.M. Mathews and is now in the American Museum of Natural History. It is registered there as no. 600712 (M. Le Croy *in litt.*).

strenua — *Pachycephala strenua* de Vis, 1898.

Vict. Parl. Pap., No. 23-5027: 85. Holotype: O.19783 (formerly M.6958, T.68), 'Wharton Range (?)', PNG. Presented by Sir William MacGregor.

subcaudalis — *Aeluroedus subcaudalis* de Vis, 1897.

Ibis, (7)3: 390. Holotype: This spirit specimen, which was collected at Mt Scratchley, PNG, has not been located. It was collected by A. Giulianetti and presented by Sir William MacGregor.

subeyanea — *Poecilodryas subeyanea* de Vis, 1897.

Ibis, (7)3: 377. Syntypes: O.20699–20702. De Vis had no exact locality data for these specimens from Papua, PNG. Presented by Sir William MacGregor.

These spirit specimens have been dried out and are now in the skin collection.

sudestensis — *Eopsaltria sudestensis* de Vis, 1892.

Qd Parl. Pap., C.A. 1–1892: 96. Holotype: This specimen, which was collected at Sudest, PNG, on 30 Jun. 1891, has not been located. Presented by Sir William MacGregor.

sudestiensis — *Geoffroyus sudestiensis* de Vis, 1890.

Vict. Parl. Pap., No. 21–(2S)–3598: 58. Holotype: This male specimen, which was collected at Sudest Island, PNG, has not been located. Presented by Sir William MacGregor.

susannae — *Paradisea susannae* Ramsay, 1883.

Proc. Linn. Soc. N.S.W., (1)8 :21. Syntype: N.W. Longmore (pers. comm.) notes that Ramsay sent a syntype (Australian Museum A.14475) to the Queensland Museum in 1883 as part of an exchange. It has not been located. The specimen (a male) was collected on the 'Island of D'Entrecasteaux' by 'Mr. Rolles'.

tyrannula — *Sericornis tyrannula* de Vis, 1905.

Ann. Qd Mus., 6: 42. Holotype?: O.17905, no data on label.

The holotype was supposedly collected at Charleville, SWQ, by K. Broadbent. Parker (1984) concluded that *Sericornis tyrannula* was a junior synonym of *Sericornis pyrrhopygius* and that the type locality should be corrected to Maryland, SEQ. Parker also suggested that O.17905 may be the holotype, but doubt must remain. The name was suppressed for the purposes of priority but not homonymy by I.C.Z.N. (1963) after a submission by Mayr (1962). Parker (*loc. cit.*) described the suppression as regrettable. Mayr (1986) said the subsequent identification of *S. tyrannula* was nomenclaturally irrelevant.

vicaria — *Paecilodryas vicaria* de Vis, 1892.

Qd Parl. Pap., C.A. 1–1892: 94. Holotype: Male, O.19776 (formerly M.7108), Mt Suckling, 6000–7000 ft, PNG, Jul. 1891. Presented by Sir William MacGregor.

vinitinctus — *Melithreptus vinitinctus* de Vis, 1884.

Proc. R. Soc. Qd, 1: 159. Holotype: Male, O.16371, Kimberley, NWQ, Jul. 1884. Collected by K. Broadbent.

viridiceps — *Neopsittacus viridiceps* de Vis, 1897.

Ibis, (7)3: 371. Holotype: Female, O.19551 (formerly M.6739), Mt Scratchley, 12200 ft, PNG, 5 Oct. 1896. Collected by 'A. Giulianetti'. Presented by Sir William MacGregor.

viridigaster — *Oreopsittacus viridigaster* de Vis, 1898.

Vict. Parl. Pap., No. 23–5027: 81. Syntypes: Male, O.19656 (formerly M.6785), 5 Oct. 1896. Female, O.19657 (formerly M.6789), 28 Sep. 1896. Female, O.19659 (formerly M.6787), 17 Sep. 1896. All collected at Mt Scratchley, 12200 ft, PNG, by 'A. Giulianetti'. Male, O.19651 (formerly M.6783, T.68). Male, O.19652 (formerly M.6782, T.68). [Male], O.19653 (formerly M.6781, T.68). Female, O.19654 (formerly M.6788, T.68). Male, O.19655 (formerly M.6786, T.68). Male, O.19709 (formerly M.6784, T.68). All collected at Wharton Range, 11 100 ft, PNG, Jul. 1897, by [A. Giulianetti]. Presented by Sir William MacGregor.

There are five syntypes missing: three spirit specimens from Mt Scratchley and two males from Wharton Range (one of which is immature). O.19564 (formerly M.7212) is most likely the 'missing' immature male. De Vis's date for the Mt Scratchley specimens was wrong — these were collected in 1896, not 1897.

viridis — *Monachella viridis* de Vis, 1894.

Qd Parl. Pap., C.A. 93–1894: 101. Syntypes: O.19766 (formerly M.6823, T.51). O.19769 (formerly M.7290, T.51). O.19770 (formerly M.6822, T.51). Female, O.19771 (formerly M.6824, T.51). All collected at Mt Maneao, PNG. Collected by 'W.E. Armit and R.E. Guise'. Presented by Sir William MacGregor.

walleri — *Strix walleri* Diggles, 1866.

Ornithology in Australia, Part VII, pl. 1, A specimen (O.11985), which has no locality data, was originally labelled '*Strix novaehollandiae*'. On the reverse side of the label there is pencilled 'walleri'. In the original card index system, the specimen is designated 'a' and therefore could be the first Grass Owl accessed. The specimen,

however, does not match either illustration in Gould (1869, pl. 1) or Diggles (1866). Diggles had examined a male and a female, both of which were in Eli Waller's possession. Waller had shot them in the immediate neighbourhood of Brisbane, SEQ. At some stage, a specimen was sent on loan to Gould (Diggles 1875b). Other than this, nothing is known of the fate of the syntypes.

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